"tail-first aircraft" and the term "canard surface" to refer to the smaller lifting surface. As indicated in paragraph [0030], consistently with the above, element 12 in the drawings is referred to as the "canard surface." Nonetheless, the Examiner's reaction may reflect a possible confusion of a reader, which is better avoided. Thus, notwithstanding the above, applicant amends claims 1 and 11 to add "two-surface" before the use of the word "canard," to avoid any possible confusion.

Applicant submits that the bases for the §112 rejections have been removed.

§103 Rejections

Preliminary Matters

Criticality of the Size of the Opening

In response to the Examiner's comments on page 3 of the Action, and as discussed above, applicant provides "criticality" for the size of the "large opening," in at least one sense, by reciting on the one hand that the craft is a personal aircraft having a gross weight limit of up to 5000 pounds and a horsepower limit of up to 500 horsepower, and by reciting on the other hand that the large opening in the rear of the fuselage is an opening through which at least one of a motorcycle, a patient or a gurney and a man in a wheelchair can be loaded.

To a person of ordinary skill in the art, the limitation on gross weight and horsepower places a practical maximum limitation on the size of the fuselage. The size of the objects to be loaded places a practical minimum limitation on the size of the rear fuselage opening. Thus, in regard to the "criticality" of the size of the opening at the rear of the fuselage, the amendments to the independent claims provide such criticality in one sense to a person of ordinary skill. E.g. on the one hand the craft is limited in size to a personal aircraft having a gross weight limit no larger than 5000 pounds and a horsepower no larger than 500 hp. On the other hand a large door at the rear of the fuselage must exist, large enough to load at least one of a patient on a gurney, a motorcycle, and a man in a wheelchair. The "criticality" of the size of the opening vis-à-vis the size of the craft is specified.

The Rutan '800 Teaches a Vertical Stabilizer on the Rear of the Fuselage.

Applicant traverses a contention that the Rutan '800 discloses an aircraft "with no empennages." See Rutan '800, Column 4 line 36-51.

> In the particular form shown, the conventional empennage group has been eliminated in favor of a pair of so-called "Whitcomb-type" winglets 20 located at the tips of the fixed wing members 22 that make up the primary wing system 14 along with the extendable area-increasing elements 24. Winglets 20 extend vertically and provide directional stability **that is customarily a function of a vertical stabilizer located amidships on the aft end of the fuselage as a part of the empennage group. A vertical fin 26 is provided amidships, however but, as shown in Fig 2 it projects vertically downward, not up.** This fin is multi-functional in that it

contributes some to the aerodynamic stability of the aircraft while, at the same time, acting as a skid to prevent the propellers 28 from hitting the ground during an inadvertent overrotation.

Amidships has plural meanings; see attachment 2, dictionary definitions. Burt Rutan uses "amidships" in the '800 quote above in the second sense, the sense of "along the central fore-and-aft line of a ship or aircraft." This is clear from the context, above. E.g. the "customary" vertical stabilizer is described as a vertical stabilizer located "amidships **on the** aft end of the fuselage," as part of the empennage group. Thus, when Rutan uses "amidships," the term does not rule out the aft end of the fuselage. In fact, Rutan discloses a novel vertical fin located "amidships" that projects vertically downward. That novel fin, POOSITA knows, is also on the aft end of the fuselage.

Supporting evidence informs one of ordinary skill that the novel fin is located on the aft end of the fuselage. E.g.:

(1) The novel fin is disclosed not only to provide aeronautical stability but also to act as a skid to prevent the propellers 28 from hitting the ground during an inadvertent overrotation. The common sense of a person of ordinary skill in the art locates a skid to protect the propellers against overrotation adjacent to the props. The location "adjacent to the props" is on the aft end of the fuselage of the '800.

(2) One of ordinary skill in the art, with deemed knowledge of all relevant prior art, including public uses and publications, also knows the information in attachment 3. The Rutan '800 design is incorporated into the Beechcraft Starship. See attachment 3 C, page 12. The Rutan '800 design was also the subject of a companion design patent. See attachment 4. It was common knowledge in the industry, and was reported in the industry, that Burt Rutan was the designer of the Beechcraft Starship; see attachment 3A, 3B, and that the Starship corresponded to the Rutan '800 patent. See attachments 3C page 12 and 3D page 5. The Beechcraft Starship clearly displays a lower vertical stabilizer on the rear or aft end of the fuselage. See attachment 4A, 4B and especially 4C, Figures 1, 6, 7 and 8. Pictures of the Starship (again, see attachments 4) clearly locate the lower vertical stabilizer on the rear of the fuselage. Accord page 167 of "Canard a Revolution in Flight" book, previously submitted.

Hence, by combination of deemed knowledge, common knowledge and common sense, the person of ordinary skill in the art knows that the '800 teaches a vertical stabilizer on the rear of the fuselage. *In re Merck* warns, in regard to obviousness, that a reference is not to be read in isolation, but as a part of the prior art as a whole.

Aircraft Design Not a Predictable Art

The field of aircraft design is not a predictable art. It is common knowledge that extensive test facilities exist, including wind tunnels, mathematical models and prototype facilities, to determine whether new designs are viable. Testing is expensive and mandatory. All non-trivial modifications, such

as a novel combination of vertical stabilization forces or thrust forces on an aircraft frame, require testing and proving. Results are not foregone, or predictable. Satisfactory results of such modifications can not be predicted by a person of ordinary skill in the art, without testing.

The lack of predictability, and the requirement for testing, is evidenced by quotes from the references themselves, produced by and relied on by the Examiner. See Rutan '800, column 3 lines 5-34, below.

> Despite these advantages [nine specific, apparently acknowledged, advantages of tandem or multi-winged aircraft (canard) over a conventional main wing forward, tail-aft design], it has not been possible to realize them in the design of modern complex high performance aircraft. For instance, if one were to equip one of the more common tandem-winged planes such as the Saab Viggen, V-70, Defiant, Quickie, VariViggen or even applicant's own Long-EZ with a set of high-lift flaps on its rear or primary wing system, the neutral point of the craft would move aft and the pitching moment would decrease beyond the ability of the secondary or forward wing system to compensate for it. In other words, to trim the aircraft to the angle of attack needed to achieve high lift, the secondary or canard wing system lacked the ability to provide same.
>
> It has now been found in accordance with the teaching of the instant invention that these and other desirable performance characteristics of tandem or multi-winged high performance aircraft can, in fact, be realized, not only in the high lift landing and take-off modes, but throughout the flight regime by the simple, yet unobvious expedient of sweeping the secondary wings fore and aft while leaving them deployed and effective at all times simultaneously and in carefully coordinated fashion with area-increasing flaps carried by and movable relative to the primary wing system. When, and only when this coordinated movement is carried out through the entire range of flight modes does it become possibly to essentially maintain the necessary relationship between the aircraft's center of gravity and neutral point required for stable flight.

Also see Wallis column 6 lines 33-51, below.

> The natural property of the body, when its longitudinal axis is inclined at a small angle to the airstream, of producing relatively large pitching moment with a negligible increase in drag is only realized when the wings are located towards the rear of the body. If the wings are attached to the body in the forward position, in the conventional manner, or even if small aerofoils are mounted at the extreme nose of the body, as in the "tail-first" aeroplane, this property is seriously interfered with, but if the attachment of any form of protuberance to the fore-body can be avoided, the preservation of an unimpeded airflow over the

> major portion of the body permits the latter to develop the full value of the pitching moment which is natural to it, so that the body itself can take the place of a conventional stabilizing surface in dynamic flight.

The Rutan quote above, for instance, informs POOSITA that notwithstanding nine significant advantages known for a canard, and notwithstanding that the canard has been known at least as long as the Wright Brothers flight, it has not been possible to realize those advantages in a design of a modern complex high performance aircraft. E.g. POOSITA is informed that one can not simply add high lift flaps to a canard, or a canard surface, to a high performance aircraft. In each case the performance of the combination is poor – providing relevant concrete examples that results are not predictable.

The Wallis quote above likewise teaches POOSITA that his simple design only performs acceptably if the wings are located near the rear of the body and if no form of protuberance is attached to the fore-body. E.g. **if** the wings are attached in the forward position in the conventional manner, or **if** small aerofoils are mounted at the extreme nose of the body, as in the tail-first airplane, (canard surface) [**note: the very combination contended to be "obvious" by the Examiner**] a natural property of the body of producing a single pitching moment with negligible increase in drag **is seriously interfered with**. The attachment of any form of protuberance to the fore-body is to be avoided, POOSITA is informed. Canard surfaces and power sources attached to the fore-body are to be avoided. Such evidences that even trivial appearing modifications to the design can spell failure.

The above quotes indicate to POOSITA, as well as does a wealth of other common knowledge, see below, that aeronautical design is a delicate science, not a predictable art. Results are not predictable. Aircraft performance contains surprises. Risks of failure are significant. Designers follow precedent to avoid surprises. Testing of structural variations is inevitable. Performance is not predictable. There may exist hope, but no a priori reasonable expectation, of success with respect to new designs. See, for instance, the Sport Aviation articles regarding Rutan and canard designs, submitted in a new IDS, as at least relevant background information.

Testing is neither cheap nor predictable. Fluid dynamics is complex. Given the unpredictableness of the art, alternate designs, although suggesting clear advantages, are not readily pursued. The industry embraces historically precedential designs where the surprises have already been uncovered.

The Prior Art Teaches Away – in Two Senses

The prior art as a whole teaches away from (1) a two-surface canard absent a rear vertical stabilizer or rear centered power source, or both; and (2) in regard to a small craft, away from a rear fuselage door without a boom supported empennage, creating a three-surface canard

> A reference may be said to teach away when a person of ordinary skill, upon reading the reference would be discouraged from the following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant. *In re Gurley*, 27 F.3d 551, 553 (Fed Cir 1994) emphasis supplied.

> In considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference, but also the inferences which one skilled in the art would reasonably be expected to draw therefrom. *In re Preda*, 401 F.2d 825, 826-27 (CCPA 1968)

Re (1)

The history of the development of canards (e.g. as disclosed in the book "Canard a Revolution in Flight" submitted previously in an IDS and as also reflected in a website list of all known canard type aircraft, attachment 6, and as reflected the Sport Aviation articles attached in a new IDS) informs one of ordinary skill that the dozens of historical canard designs all (a) teach rear centered thrust or (b) a rear centered vertical stabilizer, or both. A person of ordinary skill, upon reading the references, would be "discouraged" from designing a canard without rear centered power or rear centered vertical stabilizer, and would be "led in a direction divergent" thereto. The weight of the prior art suggests that applicant's design would be unlikely to be productive of satisfactory results.

Re (2)

References relied on or cited by the Examiner, e.g. Weaver, Weiland and the Rutan ATTT, all teach or suggest (permit POOSITA to "reasonably infer") the necessity of some conventional empennage, typically a boom supported empennage, when the fuselage incorporates a rear door. On a canard, a boom supported empennage results in a three-surface canard.

See Weaver Figure 1.

See Weiland column 1 lines 32-34, who teaches a conventional craft with the empennage on the door:

> Rear end openings have heretofore required mounting the empennage, with its movable controlled surfaces, on booms or the like that can be built integral with the fuselage, leaving a stubby fuselage with a rear door that can open, for if the empennage were on a swingable tail section the control cables or like have to be disconnected for opening movement and reconnected at closing, requiring time for reconnection, and leaving open the possibility of human error and the disastrous failure of control that would follow.

Weiland, and an apparently companion patent Pearson, discussed in column 1, themselves diverge from the above recited traditional mounting of the empennage on booms to accommodate a rear fuselage door. Weiland and Pearson teach retaining the conventional empennage on a hinged rear fuselage door. (Weiland further discusses the limitations of craft with bottom openings, namely requiring extra heavy framing to compensate for omitted or interrupted frame elements and restricting the length and sometimes thickness of the cargo units that can pass therethrough.) All of the recitations discussed in Weiland teach POOSITA the necessity of a conventional empennage (boom or not), which together with a canard surface would create a three surface canard.

See also the Rutan ATTT developmental history, attachment 5, of which one of ordinary skill in the art is presumed to be aware. E.g.

> The initial flight test program consisted of 51 flights with the original cruciform tail configuration, measuring and refining performance, stability and control and handling qualities.
>
> In an effort to improve the aft loading capability the aircraft and to correct aerodynamic deficiencies discovered during the test program, the ATTT aircraft was modified with a twin boom tail."

The ATTT resulted in a three-surface canard. One of ordinary skill, with deemed knowledge of the prior art including the teachings of references Weaver, Weiland and the ATTT developmental history, would be "discouraged" from adding a rear fuselage door to a personal aircraft without retaining a conventional empennage. Adding a canard surface to an empennage would result in a three-surface canard. A person of ordinary skill would be particularly led in the direction of the boom supported empennage, rather than the path taken by applicant. The references suggest that the line of development pursued by applicant is "unlikely to be productive." One of ordinary skill in the art could reasonably be expected to "infer" that a rear door in the fuselage of a personal two-surface canard would not fly satisfactorily.

Note that the Examiner submitted references Weiland and Hawley as "pertinent" to applicant's disclosure. Hawley discusses the background and history of "tailless" craft and does not recognize a "tailless canard." Weiland discusses the background of rear-opening craft and does not recognize a "rear opening tailless" craft. Such is "pertinent." Such also informs POOSITA.

(Specifically, Hawley was filed in June of 1997. The assignee is McDonald Douglas. The invention was made under contract with NASA. Hawley teaches there are two types of aircraft. The conventional figuration includes a tail section composed of a vertical and horizontal stabilizer located at the aft end of a tubular fuselage. The second configuration is the "tailless" configuration, of which there are two types. The first type has no central body and is commonly known as a flying wing. The second type has a central body blended into laterally extending wing. Hawley does not teach or suggest the existence of a "tailless canard" type.)

(Weiland, assigned to Boeing, filed in 1959, teaches that rear openings "heretofore" have required mounting the empennage, with its moveable control surfaces, <u>on</u> <u>booms</u> or the like. Column 1 lines 32-34. Accord Rutan ATTT. Weiland diverges from this historical path with a conventional empennage mounted on a hinged rear door. One of ordinary skill in the art informed by the teachings of Burt Rutan, Boeing and McDonald Douglas, significant authorities in themselves, would be "discouraged" from creating a two-surface canard absent any empennage with a large rear fuselage door. Based on these disclosures of Rutan, Boeing and McDonald Douglas, a design of a <u>two</u>-surface canard with a large rear door would unlikely to be productive of viable results.)

<u>§103 Rejections Over Rutan '800 in View of Rutan ATTT</u>

The Examiner rejects claims 1, 3-6 and 8-11 under §103 over Rutan 4641800 in view of Rutan ATTT, as follows:

> "Rutan ['800] discloses that canards with pitch control surfaces on an aircraft with no empennages and two significant horizontal surfaces are well known in the art. Rutan lacks the door at the rear of the fuselage. Rutan ATTT does teach using a door at the rear of the fuselage.
>
> It would have been obvious to one skilled in the art at the time the invention was made to have used doors at the end of the fuselage in Rutan's ['800] system as taught by Rutan ATTT to easily load cargos and to increase maneuverability." See Action page 3.

(Applicant traverses the contention that the '800 has no empennage, as above. As would be understood by one of ordinary skill in the art deemed to have knowledge of all relevant prior art as well as common knowledge and common sense, the '800 <u>has</u> a downward vertical stabilizer on the aft end of the fuselage.)

<u>Re Independent Claims – 1 and 11</u>

<u>Taking the Proposed "Combination of Elements" Literally</u>

Taking the proposed "combination of elements," above, literally, together with the maximum practical size of the aircraft and the minimum practical size of the opening in the rear of the fuselage, it would be, if not impossible, at the least "uniquely challenging or difficult" for one of ordinary skill in the art to construct a "large" opening for the recited large object on the aft end of the '800 aircraft, appropriately scaled for a personal aircraft, as recited. One of ordinary skill knows (attachment 3) that the '800 craft would have to be scaled down 100% or more to meet the specific gross weight limit and horsepower limit specified. See attachment 3B. The rear fuselage opening must load at least one of a motorcycle, a patient on a gurney and a man on a wheelchair, which would mean loading <u>through</u> the '800 rear centered pusher engines and props. One of ordinary skill would know that aircraft design does not countenance threading a load through the props of a craft. Common knowledge and common sense

dictates to one of ordinary skill that such loading is unacceptable. The risk of damage to the props and personnel is unacceptable. The approach to the door is between the left and right props whose tips, in the non-scaled down version, each appear about a foot off the longitudinal axis. Further, the swept back wings terminate aft into a tapered, narrow fuselage. (See also attachments 3 and 4.) The integrity of the connection of the wings to the craft should not be compromised by the door. It would be uniquely challenging or difficult, to say the least, to devise a door for the tapered fuselage, between the wing connections, as scaled down for a personal craft, large enough to load at least one of a motorcycle, a patient on a gurney, and a man in a wheelchair.

Scaling the '800 down and adding a rear fuselage door sufficient to load at least one of a motorcycle, a patient on a gurney and a man in a wheelchair to the '800 craft, the '800 craft scaled down to meet the structural limitations of a personal aircraft, is practically speaking impossible.

Considering Necessary Modifications, Practically Speaking

One of ordinary skill in the art, to achieve applicant's design from the '800, would believe that, 1) the rear centered pusher engines would have to be moved and 2) the rear vertical stabilizer would have to be removed, both to accommodate the necessary rear fuselage door. The tapered fuselage and wing connection would also have to be re-designed to accommodate the door. The fuselage shape and wing shape would have to be altered.

There are no predictable results here. Tolerances are tight and the degree of interdependence of function is high. There are warnings from Rutan, as to the narrow limits of permissible variations on the '800 design. (See below quotes.)

> Figs 3 and 6 show an allowable c.g. range C(F) to C(A) within which stable and controlled flight can be maintained.
>
> More important, however, is the fact that moving one or the other [element 24 of the primary wing system and the sweep angles of the secondary wing system 16] brings about a change in the spaced relationship under any given set of conditions between the c.g and N.P. which, if allowed to exceed certain limits, will have an adverse effect upon the stability. In other words, regardless of the position of the c.g. within its predetermined allowable limits, there exists a narrow range of positions of the N.P. relative thereto which will result in stable, controllable trimmed flight.
>
> In other words, were it not for this coordinated simultaneous deployment of these lifting surfaces into their fully-extended positions, the neutral point in the high-lift mode N(L) would, or at least could, shift forwardly of the center of gravity thus producing an unstable and unsafe flight condition.

Rutan '800 column 6 lines 60-62; column 7 lines 7-15; column 8 lines 34-39. Emphasis supplied.

The source of power and the source of vertical stabilization are significant forces impacting flight and stabilization. A relocation of those forces, with the concomitant relocation of the center of lift, the neutral point and the center of gravity, (key issues discussed by Rutan in column 6 lines 490 column 7 line 37) would necessitate, at the least, testing to determine maneuverability and stability of the craft under required flying circumstances.

Evidence That the Modifications Necessary to Effect the Combination of Elements is Uniquely Challenging or Difficult

Again, the "combination of elements" proposed by the Examiner is as follows:

> "It would have been obvious to one skilled in the art at the time of the invention was made to use doors at the end of the fuselage in Rutan's ['800] system as taught by Rutan ATTT and to easily load cargos and to increase maneuverability." See Action Page 3.

Deficiency of Prima Facie Case

As discussed above, practically speaking, to add a rear fuselage door to the '800, scaled as a personal aircraft, the aft vertical stabilizer would have to be removed. The fuselage and the wings would have to be redesigned. The aft centered power would have to be moved.

Note: if the aft centered power were moved further out on each wing, the operation of the flaps 24, crucial to the '800 invention, would be compromised. If the aft centered power were re-placed on the nose (tractor engine) the location of, and relationship between, the center of gravity and neutral point (Figure 6) would be destroyed. Stable and controlled flight would be comprised. Likely the '800 would no longer work for its intended purpose.

The proposed "combination of elements" quoted above, does not state how removal of the '800 rear vertical stabilizer or relocation of the power source are to be accommodated. The proposed "combination of elements" does not provide a basis for a reasonable expectation of success of any such redesign, nor specify how it renders the '800 capable of operating for its intended purpose. The prior art and Rutan caution against such changes.

Specifically, no basis is provided, in references, common knowledge or common sense, to support a reasonable expectation of success in regard to the significant modifications above. The prior art teaches away. There exists no evidence of successful flight with such modifications. The proposed modifications ignore that the prior art of canards as a whole, of the rear opening fuselages as a whole, and of the ATTT developmental history in particular, all of which teach away from such re-configuration.

Applicant has produced evidence from the relevant prior art, teaching POOSITA the pitfalls involved in making significant adjustments to a craft's design, the real possibilities for creating failure,

the "non-obvious" sensitivity of elements in regard to their inter relateability. The Examiner produces no evidence of the prior art teaching to the contrary.

Uniquely Challenging or Difficult

The modifications necessary to effect the combination of elements, above stated, would, at the least, be uniquely challenging or difficult for one of ordinary skill in the art. Precedent, the weight of authority, the history of aircraft design, and the prior art as a whole, (all deemed knowledge of POOSITA) teach the advisability, in a two-surface canard, of locating either the power force or a vertical stabilizer on the rear of the fuselage. There exists no basis for reasonable expectation of success for a design that eliminates both the power and the vertical stabilizer from the rear fuselage. If a rear fuselage door were desired, precedent, authority, and the prior art teach to use a boom supported empennage and a three-surface canard.

Scaling the '800 design for a personal aircraft (having a gross weight limit of 5000 pounds and a horsepower limit of 500 horsepower,) while at the same time re-designing for an opening in the rear of the fuselage large enough to load at least one of a motorcycle, a patient on a gurney and the man in a wheelchair, indicates to the person of ordinary skill that the slender rear fuselage of the '800 must be re-designed to be wider and taller. The swept back wings of the '800 must be re-designed to attach further forward on the fuselage body to avoid interfering with the large opening in the rear of the fuselage. Both of the redesigns of wings and fuselage result in a change in the overall lift factors on the plane and a change in the center lift and the neutral point. The effect of such changes must be tested. Favorable results are not predictable. The required modification is a significant re-design, not a mere optimization of elements. To make the modifications necessary to re-design the '800 to effect applicant's invention would be uniquely challenging or difficult for POOSITA, at the least. The prior art teaches away from making these modifications. At the outset there is no reasonable expectation of success. Absent knowledge of the teaching of applicant, based on surprising testing, there is no reasonable expectation for success.

The instant combination is not a predictable use of prior art elements according to their established functions. The predictable use of a two-surface canard is with rear power and/or a rear vertical stabilizer. The predictable use of a rear fuselage door on small craft is with a boom supported empennage. The elements of a craft affecting power, lift, center of gravity, neutral point, center of lift, horizontal stability, vertical stability, pitch, roll and yaw, function in combination. They are interrelated. The functioning of a significantly new interrelationship is not "established." It must be learned. When prior art aeronautical elements are significantly rearranged, their functionality in combination must be learned.

<u>Summary – Re Rejection over Rutan, Independent Claims 1 and 11</u>

In summary, a person of ordinary skill in the art would know, by common knowledge and by deemed knowledge of the prior art, that:

- Canard designs (tail-first craft) have existed for a hundred years and known dozens of designs all employ at least one of (1) aft centered thrust; (2) aft centered vertical stabilizer; (3) a boom supported empennage.
- Burt Rutan, preeminent contemporary experimental aircraft designer, well known for using canard surfaces, the inventor of the '800 patent of which the Beechcraft Starship is the commercial embodiment, teaches aft centered power <u>and</u> a rear fuselage vertical stabilizer for the '800 Beechcraft.
- Burt Rutan, as designer of the ATTT, teaches that a canard with a rear fuselage door needs a boom supported empennage, needs therefore to be a <u>three</u>-surface canard.
- Aeronautics is not an art in which basic elements affecting forces on a craft can be significantly re-located with predictable results. Design and testing is fraught with surprise and failure as well as success. Accord Weiland, Weaver and Rutan.
- The ATTT developmental history and the canard development history, in combination, teach away from a <u>two</u> surface canard with a rear fuselage door. The ATTT development history teaches that a rear fuselage door on a canard requires a boom supported empennage, a <u>three</u>-surface-canard. The '800 teaches away from a significant alteration to of its center of gravity and neutral points.

The instant invention is more than a predictable use of prior art elements according to their established functions (KSR) for POOSITA. The elements (two-surface canard, personal aircraft, large rear fuselage door) have been long known. They have never been combined as in the instant application. Whether the elements in combination perform according to their established further (produce satisfactory flight) can only be evaluated in combination. This is <u>not</u> a case where the performance by an element of its function can be judged <u>out</u> of combination with other elements. The elements in the instant case are inextricably related. Performance of function by one element is interrelated with the performance of the combination. The performance of established function by a <u>novel</u> combination of elements in aircraft design, as disclosed herein, is not predictable to POOSITA. Thus, the instant application is not a predictable use of prior art elements according to their established functions.

As taught *in re Merck*, a reference "must be read, not in isolation, but for what it fairly teaches in combination as a whole." 800 F.2d 1091, 1097. The Rutan '800 reference, read in combination with the prior art as a whole by POOSITA, (as evidenced by attachments) teaches (1) a rear vertical stabilizer. A rear vertical stabilizer is essentially incompatible with a large rear fuselage door on a personal sized

aircraft. (2) The '800 as well as the prior art as a whole structures the engines of a two-surface canard as close together to the axis as feasible, as is safe, as illustrated by the '800 patent, its associated design patent, and the Beechcraft commercial embodiment, all known by POOSITA. Axially centered thrust for a two-surface canard is taught both by the '800 and by the prior art as a whole, and it is taught to be important, not trivial. Axially centered thrust avoids, or minimizes, the problems associated with asymmetrical thrust when operating with one engine, or with one engine out. Thus, it is not obvious to POOSITA, based on the references and the prior art as a whole, that the '800 would perform in accordance with its established function if the two rear pusher engines were not axially centered as close as feasible and safe, but rather spaced apart. However, axially centered thrust is incompatible with a large rear fuselage door. (3) The Rutan ATTT developmental history, read in combination with the prior art as a whole by POOSITA (evidenced by attachments), teaches away from a rear fuselage door on a <u>two</u>-surface canard. Thus, the prior art as a whole and the '800 in particular teach away from the necessary modifications to elements in the prior art to reach applicant's invention.

The prima facie case of the Examiner violates the principle of *In re Merck*. The prima facie case does not present or evaluate evidence of the teachings of the prior art as a whole on the subject. Rather, the prima facie case impermissibly reads the Rutan '800, and the ATTT, in isolation. As an initial matter POOSITA could not help but be influenced by the teachings of the prior art as a whole. The prior art of aviation of aircraft design as a whole teaches away from canards. Canards were initially proposed, used by the Wright Brothers, and have been long since been discarded. To the extent it is considered obvious for POOSITA to consider a minor theme in the history of aircraft design, the "two-surface canard" design, POOSITA would be <u>unlikely</u> to vary further from the accepted designs in the two-surface canard field. The level of rigorous testing required would appear too extensive, too unreasonable and too unprofitable.

<u>§103 Rejection of Claims 1, 3, 5, 6, 9, 10 and 11 as Unpatentable Over Wallis in View of Rutan '800 and Weaver</u>

The Examiner asserts, on page 6 of the Action:

> Wallis discloses an aircraft having one wing 11-12 but without empennages but is silent on the opening at the rear of the fuselage and canards. However, Rutan '800 discloses that canards with pitch control surface are well known in this day and age. Weaver et al shows an opening 17 at the rear of the fuselage is well known.
>
> <u>It would have been obvious</u> to one skilled in the art at the time invention was made <u>to have used canards</u> as well as openings at the rear <u>in Wallis' system</u> as taught be Rutan and Weaver et al to have a more maneuverable aircraft as well as easier loading and unloading.

Applicant traverses that it would have been obvious to one skilled in the art at the time the invention was made to use a canard as well (as an opening in the rear of the fuselage) in the Wallis single wing craft. Applicant traverses both assertions.

Wallis Explicitly Teaches Away from the Combination – Claims 1 and 11

Wallis explicitly states that either the use of a canard or the movement of the wings away from the rear of the body would seriously interfere with the performance of Wallis' plane. Wallis, teaches away from such. E.g. Wallis teaches a craft with one and only one wing, which performs both the function of lift and pitch control of the aircraft. Wallis teaches of the importance of attaching the wing towards the rear of the fuselage, which design does not permit "loading" the claimed "large objects" into a personal aircraft. Wallis' wing extends through the fuselage.

Wallis teaches the importance of no protuberance on the fore-body and of attaching the wing through an aft portion of the fuselage. On page 6 lines 33 -51 Wallis explicitly teaches:

> "If the wings are attached to the body in the forward position, in the conventional manner, or even if small aerofoils are mounted at the extreme nose of the body, as in the "tail-first" aeroplane, this property [pitching movement of body] is seriously interfered with, but if the attachment of any form of protuberances to the fore-body can be avoided, the preservation of an unimpeded airflow over the major portion of the body permits the latter to develop the full value of the pitching moment which is natural to it, so that the body itself can take the place of a conventional stabilizing surface in dynamic flight."

Wallis teaches explicitly away from a two-surface canard and from a wing sufficiently forward on the fuselage such that large objects could be loaded through the rear of the fuselage.

Wallis' craft needs no canard surface because his one and only one wing (or pair of wings 11 and 12, left and right if you like) performs the function of lift and pitch control. This is the essence of Wallis' invention. Wallis explicitly teaches that adding a canard surface would destroy his invention.

Wallis does not teach a craft with a power source. If a power source were added, it could not be added to the forebody because, like a canard surface, it would destroy Wallis' invention. Power sources cannot be added to the wing, because the wing is mobile in regard to the fuselage. One of ordinary skill in the art would understand that such mobile wing extending through the body of the fuselage would not be expected to carry the weight of the engines. Hence, were Wallis' craft to be powered, the powered source would have to be located at the rear of the fuselage. Such location of the power source is incompatible with a large rear opening to load large objects.

Again, the wing structure explicitly taught to be located on the aft portion of the fuselage and extending through the fuselage does not permit loading large objects into the fuselage. One of ordinary skill in the art would know that using a canard surface in front of the wing, as well as incorporating a

large opening in the rear of the fuselage for loading large objects, are both incompatible with the Wallis system.

Dependent Claim 7 – Either Set of References

In regard to the rejection under §103 over Rutan '800 as modified by Rutan ATTT, or over Wallis in view of Rutan '800 and Weaver and Burnelli, the additional tractor engine limitation is asserted to be obvious in view of admitted prior art. The Examiner contends that the admitted prior art, namely successful testing of a canard aircraft with a single tractor engine, renders it obvious to one skilled in the art to use a tractor engine, in the Rutan system or the Wallis system, to have the predictable result of more efficient thrust production. Applicant respectfully traverses.

The "admitted prior art" is documented in attachment 7 by the Dragonfly, awarded best new design at the 1980 Oshkosh convention, and the Quickee, generally regarded as a near identical craft. Both the Dragonfly and the Quickee have a substantial cantilevered vertical stabilizer at the rear of the trimmed down fuselage. The substantial rear vertical stabilizer in the history of two-surface canard designs is inseparable from the tractor engine design, and is incompatible with a large rear fuselage door. See the 1981 Sport Aviation article, entitled Quickie-Type Aircraft Design Origins (new IDS) where Rutan refers to the design as the "tandem-canard/vertical-fin-on-fuselage" configuration.

Again, dealing with the combination of references specifically, if the rear centered power of the '800 were changed to a single front tractor, the center of gravity, by virtue of the change of the location of the weight of the engine(s), would be radically shifted forward. Such shifts the location of the force vectors on the craft and the relationship of the center of gravity to the neutral point, and/or to the center of the lift. Any such re-design would discouraged by Rutan (see above) and would have to be tested using mathematical models, wind tunnels and prototypes. There is no basis for a general expectation of success. Positive results are not predictable. Wallis specifically teaches that any protuberance of the fore-body destroys his invention.

Conclusion

Claims 1 and 11

The Examiner's literal "combination of elements:" e.g.:

- adding the ATTT "aft loading capability," or the rear fuselage door of Weaver, as "a large opening at the rear of the fuselage through which large objects, including at least one of a motorcycle, a patient on a gurney, and a man in a wheelchair can be loaded," without more, to the Rutan '800 properly scaled to a personal aircraft (e.g. with a gross weight limit of 5000 pounds and a horsepower limit of 500 horsepower) which scaling POOSITA would know requires scaling the '800 embodiment down at least 100%, (see attachment 3)

is not feasible. Reasons:

- (1) props of the '800 aft centered engines prohibit or impermissibly interfere with loading;
- (2) the scaled down '800 rear fuselage is too small to permit the recited "large opening" through which the "large objects" can be loaded; and
- (3) the structural integrity of the '800 rear vertical stabilizer would be compromised by adding a large rear fuselage door,

all as understood by POOSITA.

Furthermore (4) both the ATTT developmental history, of which POOSITA is deemed aware and the Weaver reference teach that a large rear fuselage door goes hand in hand with a boom supported empennage. The boom supported empennage violates the "two-surface canard" limitation. It also violates the "having no empennage" limitation of claims 3 and 4 and independent claim 11.

To the extent the Examiner is proposing unspecified "modifications" of the '800 together with the inclusion of the ATTT or Weaver rear fuselage door, it is difficult to traverse unspecified modifications. POOSITA would know, however, that the possible modifications are significant and that the results of flight of the new design are not predictable. Such is based on the general level of predictability in, and the history of prior art in, aeronautics and the development of private aircraft design.

Whatever modifications the Examiner might be implicitly suggesting in regard to the design of the '800, modifications of the '800 necessary to reach applicant's claim 1, they are significant. The new combination is not known in the art. There is no precedent predicting favorable flight results. The weight of the prior art teaches away from the modification. The modification is not a "predictable variation." Given the art of aeronautical design, in particular in the field of personal aircraft, and given the significance of the Examiner's literal combination and/or "possible" modifications to the '800, in light of what POOSITA would understand based upon common knowledge, common sense, and deemed knowledge of all relevant prior art, the conclusion is that the literal combination is not feasible, and the "possible" modifications produce a design for which successful flight results are not predictable, and a design in regard to which the prior art teaches away.

Reconsideration and further examination is respectfully requested.

Applicants have made a diligent effort to place the claims in condition for allowance. However, should there remain unresolved issues that require adverse action, it is respectfully requested that the Examiner telephone Sue Z. Shaper, Applicants' Attorney at 713 550 5710 so that such issues may be resolved as expeditiously as possible.

For these reasons, and in view of the above amendments, this application is now considered to be in condition for allowance and such action is earnestly solicited.

Respectfully Submitted,

3/18/9
Date

Sue Z. Shaper
Attorney/Agent for Applicant(s)
Reg. No. 31663

Sue Z. Shaper
1800 West Loop South, Suite 1450
Houston, Texas 77027
Tel. 713 550 5710

Attachment 1

Canard

From Wikipedia, the free encyclopedia

Canard is a French word for a duck, and is often used in English to refer to a deliberately false story, originating from an abbreviated form of an old French idiom, "*vendre un canard à moitié*," meaning "to half-sell a duck." In French it can also mean a journal. It may refer to:

- Canard (aeronautics), flight control surfaces mounted at the front of an aircraft or an aircraft bearing such surfaces
- *Le Canard enchaîné*, a satirical French newspaper. The newspaper itself gave birth to another meaning for canard: newspaper.
- Canard (dynamical systems), is a phenomenon in some slow-fast dynamical systems referring to high sensitivity of a periodic orbit to a parameter [1] (http://www.scholarpedia.org/article/Canards). Canards are used in some models of neuronal spiking.

Retrieved from "http://en.wikipedia.org/wiki/Canard"
~~Category: Disambiguation pages~~
Hidden categories: All disambiguation pages | All article disambiguation pages

Merriam-Webster
Merriam-Webster OnLine

Also Visit: | Unabridged | Visual | Britannica Online Encyclopedia | ESL: | Learner's NEW | for Kids: | W

Dictionary Thesaurus Spanish/English Medical

- Home
- Visit Our Sites
- Premium Services
- Downloads
- Word of the Day
- Word Games
- Open Dictionary
- Spelling Bee Hive
- Word for the Wise
- Online Store
- Help
- About Us

canard

One entry found.

On Off

Main Entry: **ca·nard**
Pronunciation: \kə-ˈnärd *also* -ˈnär\
Function: *noun*
Etymology: French, literally, duck; in sense 1, from Middle French *vendre des canards à moitié* to cheat, literally, to half-sell ducks
Date: 1851

1 a : a false or unfounded report or story ; *especially* **:** a fabricated report **b :** a groundless rumor or belief
2 : an airplane with horizontal stabilizing and control surfaces in front of supporting surfaces ; *also* **:** a small airfoil in front of the wing of an aircraft that can increase the aircraft's performance

Learn more about "canard" and related topics at Britannica.com

See a map of "canard" in the Visual Thesaurus

Pronunciation Symbols

Share this entry:

Link to this page:
canard

Cite this page:

MLA Style
"canard." Merriam-Webster Online Dictionary. 2009.
Merriam-Webster Online. 26 February 2009

Browse t
A B C D E
Z #

Feed Yo
Sign up for
words and t
directly to yo

See the
Explore you
Merriam-We

<http://www.merriam-webster.com/dictionary/canard>

APA Style
canard. (2009). In *Merriam-Webster Online Dictionary*.
Retrieved February 26, 2009, from http://www.merriam-webster.com/dictionary/canard

Products | Premium Services | Company Info | Contact Us | Advertising Info | Privacy P

canard Search

Related Searches
on Ask.com
canard wing
aircraft canards
canard airplanes
canard aircraft des...
canard design

Synonyms

exaggeration
fabrication
fib
hoax
lie
rumor
spoof
swindle

More Synonyms»

Nearby Entries

Canap'e
Canap'e confident
canapé
canape
canara
Canard
canard wing
canard's
canards
canards'
Canarese

canard - 5 dictionary results

ca□nard

[kuh-nahrd; Fr. ka-nar] Show IPA

–noun, plural -nards [-nahrdz; Fr. -nar] Show IPA .

1. a false or baseless, usually derogatory story, report, or rumor.
2. Cookery. a duck intended or used for food.
3. Aeronautics.
   a. an airplane that has its horizontal stabilizer and elevators located forward of the wing.
   b. Also called canard wing. one of two small lifting wings located in front of the main wings.
   c. an early airplane having a pusher engine with the rudder and elevator assembly in front of the wings.

Origin:
1840–50; < F: lit., duck; OF quanart drake, orig. cackler, equiv. to can(er) to cackle (of expressive orig.) + -art -ART, as in mallart drake; see MALLARD

Dictionary.com Unabridged

Cite This Source

NEW Language Translation for : **canard**
Spanish:**pato**,German:**die Ente**,
Japanese:□
More Translations »

ca·nard (k□-närd') Pronunciation Key
n.

1. An unfounded or false, deliberately misleading story.
2.
   a. A short winglike control surface projecting from the

a. A short winglike control surface projecting from the fuselage of an aircraft, such as a space shuttle, mounted forward of the main wing and serving as a horizontal stabilizer.
b. An aircraft whose horizontal stabilizing surfaces are forward of the main wing.

[French, *duck, canard*, probably from the phrase vendre un canard à moitié, *to sell half a duck, to swindle*, from Old French quanart, *duck*, from caner, *to cackle*, *of imitative origin*.]

The American Heritage® Dictionary of the English Language, Fourth Edition

Cite This Source

Canard

Ca*nard"\, n. [F., properly, a duck.] An extravagant or absurd report or story; a fabricated sensational report or statement; esp. one set afloat in the newspapers to hoax the public.

Webster's Revised Unabridged Dictionary, © 1996, 1998 MICRA, Inc.
Cite This Source

canard

noun
a deliberately misleading fabrication

WordNet® 3.0, © 2006 by Princeton University.
Cite This Source

canard
before 1850, from Fr. "a hoax," lit. "a duck," said by Littré to be from the phrase vendre un canard à moitié "to half-sell a duck," thus, from some long-forgotten joke, "to cheat." From O.Fr. quanart, probably echoic of a duck's quack.

Online Etymology Dictionary, © 2001 Douglas Harper
Cite This Source

SHARE THIS PAGE ...

Embed as HTML

<a href='http://dictionary.reference.com/browse/canard?qsrc=2886'>can

Search another word or see **canard** on Thesaurus | Reference

canard Search

Attachment 2

amidships - 4 dictionary results

a·mid·ships [*uh*-mid-ships] ? Show IPA

-adverb

1. in or toward the middle part of a ship or aircraft; midway between the ends.
2. along the central fore-and-aft line of a ship or aircraft.
3. in or toward the center of anything: *a long, narrow office with a desk placed amidships.*

-adjective

4. of, pertaining to, or located in the middle part of a ship or aircraft.

Also, a·**mid**·ship.

Origin:
1685–95; AMID + SHIP + -S [1]

Dictionary.com Unabridged
Based on the Random House Dictionary, © Random House, Inc. 2009.
Cite This Source

NEW Related Words for : **amidships**
amidship, midships
View more related words »

VISUALTHESAURUS
amidships

Explore the Visual Thesaurus »

a·mid·ships (ə-mĭd'shĭps') Pronunciation Key

adv. Midway between the bow and the stern.

The American Heritage® Dictionary of the English Language, Fourth Edition

Cite This Source

Amidships

A*mid"ships\, adv. (Naut.) In the middle of a ship, with regard to her length, and sometimes also her breadth. --Totten.

Webster's Revised Unabridged Dictionary, © 1996, 1998 MICRA, Inc.
Cite This Source

amidships

adverb
at or near or toward the center of a ship; "in the late 19th century, engines were placed in front, amidships, and at the rear"

WordNet® 3.0, © 2006 by Princeton University.
Cite This Source

Embed as HTML

<a href='http://dictionary.reference.com/browse/amidships?qsrc=2886'>

Search another word or see **amidships** on Thesaurus | Reference

amidships Search

Attachment 3

Attmt 3A

Burt Rutan Takes Us to the Stars

Driven by the recent success of SpaceShipOne, Burt Rutan seeks to show the world his dream of a space tourism industry—and make it come true.

Burt Rutan knows what he wants and he doesn't aim low. "I would like to achieve a goal that NASA has neglected: to make flight outside the atmosphere accessible to common man by making sub-orbital flights available to 'space tourists,' " he says. Rutan is not alone in this dream. According to a study by the Bethesda, Md.-consulting firm Futron Corp., a forecast for suborbital space travel predicts that by 2021, more than 15,000 passengers could be flying annually, generating revenues in excess of $700 million.

It is Rutan's contributions to this goal along with his countless innovative aerospace designs that have earned him R&D Magazine's 2004 Innovator of the Year award. He joins the ranks of previous winners Larry Page, Google; Ian Foster, Argonne (Globus ToolKit); and Stuart Parkin, IBM (Spintronics).

Pushing the envelope

As president/CEO of Scaled Composites, Mojave, Calif. (see sidebar), Burt Rutan credits his mentor Wernher von Braun the first director of NASA's Marshall Space Flight Center with teaching him that people can set their sights extremely high and then go for them.

In the early 1970s, as director of the Bede Test Center, Bede Aircraft, Newton, Kan., Rutan was responsible for the design and development of the BD-5J jet, the world's smallest private jet aircraft.

After founding Scaled Composites in 1982, Rutan embarked on his most expensive project, the Beech Starship. It turned out to be just one in a series of his trademark experimental and unique aircraft designs. The most notable was Beech's Model 2000 Starship, an all-composite craft that used rudders on upturned "winglets" at the end of each wing (instead of a conventional tail), in addition to a variable-sweep canard. The result was a high-performance, stall-free aircraft that accommodated two pilots and eight passengers and could keep up with small business jets.

When asked of his most pivotal project that changed the way people regard aircraft design, Rutan feels it is certainly the Voyager aircraft, which made history in 1986 with its around the world, non-refueled flight doubling an existing range record. However, when speaking of his single largest success, Rutan knows it happened on June 21, 2004.

On that day, SpaceShipOne hitched a ride beneath the White Knight, a matching jet-powered aircraft, which carried the rocket to an altitude of about

Looking to the prize

In 1995, Peter Diamandis, a communications and aerospace entrepreneur and chairman, president, and founder of the X PRIZE Foundation, proposed the idea that a prize be offered to the first private team to develop a ship that will "jump start the space tourism industry." In May 1996, the X PRIZE was announced: $10 million to the first team able to privately finance and build a ship capable of flying three people to 100 km altitude, twice within a two-week period, and returning safely to earth. Currently, 26 teams from seven nations are competing.
In his testimony to the House Subcommittee on Space and Aeronautics (July 15, 2003) Diamandis attributed the success of the X Prize to three key components: the rules, which were well thought through and clearly presented; the "romance and excitement involved with the prize topic;" and the existence of a business or market to support the teams after the prize was won.
Although SpaceShipOne's flight on June 21st did not qualify as an ANSARI X PRIZE flight since it only carried one pilot, it was needed preparation for the competition flight attempts Scaled Composites plans to make this September and October.

The company behind the man

Scaled Composites is an aerospace and specialty composites development company located in Mojave, Calif. Founded in April 1982 by Burt Rutan, Scaled has a broad experience in air vehicle design, tooling and manufacturing, specialty composite structure design, analysis and fabrication, and developmental flight testing.
In June 1985, Scaled was sold to Beech Aircraft Corp., acquired by Wyman-Gordon Co., North Grafton, Mass., in January 1989, and then sold to 11 private investors (including Rutan) in September 2000. Rutan has been president/CEO since its formation in 1982.
The company is headquartered in three flight line buildings located on the Mojave Airport and employs 130 people. Since most of the projects done by Scaled are proprietary to the customer, the facility is closed to the public.

Burt Rutan

Current position: Founder and president/CEO of Scaled Composites,

15 km before being released. Climbing to an altitude of 100 km, SpaceShipOne took only 25 mins to make its way into history as the first non-government supported manned flight to exit Earth's atmosphere. Credited as the most fun, yet most difficult project that he has ever worked on, Rutan and his team at Scaled Composites plan to enter this innovative aircraft (entirely funded by Paul Allen, co-founder of Microsoft) into the ANSARI X PRIZE contest (see sidebar).

"I think that the SpaceShipOne flight is by far much more significant than the around the world Voyager flight," he says. "The main reason is that while the Voyager flight was a significant aerospace milestone, it didn't lead to anything. I think this is going to lead to a new space race, or a new space age and one that people can enjoy, instead of just the government and astronauts."
"The U.S. has an enormous capability because it sends engineers out to be entrepreneurs, and that's why we've excelled at things like software and computers," he adds. "I believe that same talent, applied to space travel, is going to be the next really big thing, whereas computers have been the 'big thing' over the last 20 years. I expect to see the U.S. as the leader in providing affordable space access in the future."

The first but not the last
More recently, Rutan, working with Richard Branson and Virgin Atlantic Airways, has designed the Virgin Atlantic GlobalFlyer. Built by Scaled Composites, the new GlobalFlyer is a turbofan aircraft fitted for a single pilot and engine. The ultra-light plane is made entirely from composite materials and can carry more than four times its own weight in fuel. Debuted in January, it had a successful test run in March, and hopes to set the world record for the first solo, non-stop, non-refuelled circumnavigation of the world later this year.

Rutan is understandably hush-hush on any future projects, but feels that his company will take a similar approach to those as they did with his latest project, SpaceShipOne, which was unveiled after being in design for eight years and under development for two years.

Burt, we can't wait.

--Lorraine Joyce

ANSARI X PRIZE, www.xprize.com
Futron Corp., 301-913-9372, www.scaled.com
Virgin Atlantic GlobalFlyer, www.virginatlanticglobalflyer.com

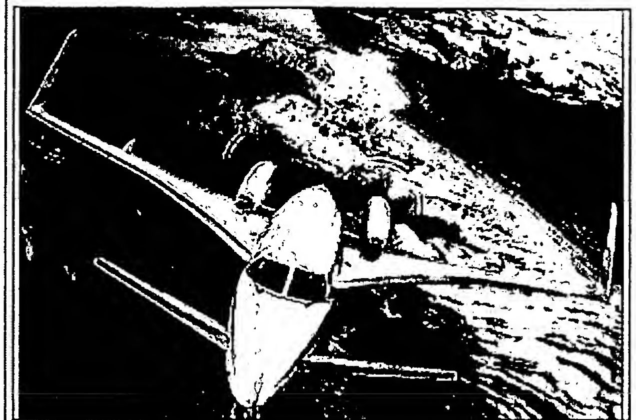
Mojave, Calif. (privately-owned)
Education: B.S. Aeronautical Engineering, California Polytechnic Univ., third in graduating class; Space Technology Institute, California Institute of Technology; Academic portion of Aerospace Research Pilots School, Edwards Air Force Base.
Member: Experimental Aircraft Association; Society of Experimental Test Pilots; American Inst. of Aeronautics & Astronautics; Society of Flight Test Engineers; Academy of Model Aeronautics; International Order of Characters; Aircraft Owners and Pilots Association; National Academy of Engineering.
Awards: "Business Leader in Aerospace" presented by Scientific American, November 10, 2003; The Reed Aeronautics Award presented by the American Institute of Aeronautics and Astronautics, May 9, 2001; Presidential Citizen's Medal presented by Ronald Reagan, December 29, 1986, for the design/development of the Voyager "around-the-world aircraft."
Projects: White Knight (an airborne launch aircraft) and SpaceShipOne (a three-person, high-altitude research rocket); Virgin Atlantic GlobalFlyer (aiming to set a world record for the first solo, non-stop, non-refueled circumnavigation of the world); Proteus (high altitude long endurance aircraft) for different scientific missions; Voyager aircraft (designed by Rutan Aircraft Factory Inc., Mojave, Calif.).
Patents held: Grizzly wide-chord flap suspension system, U.S. Patent Number 4,614,320; Variable geometry high lift system incorporated in the Beech Starship, U.S. Patent Number 4,641,800 (foreign patents also held); Rutan Model 115 Starship configuration, U.S. Patent Number Des. 292,393 (foreign patents also held)

Beechcraft Starship

From Wikipedia, the free encyclopedia

The **Beechcraft Starship** is a futuristic-looking United States turboprop-powered six- to eight-passenger seat business aircraft. The design was originated by Beechcraft in January 1980 as Preliminary Design 330 (PD 330). Burt Rutan was subsequently retained to refine PD330 and one of the significant changes he instituted was the addition of variable geometry to the canard (he holds a patent for this). Rutan's California-based design and fabrication company Scaled Composites was then contracted to build scale-model prototypes to aid in development.

Model 2000 Starship



Role	Executive transport
Manufacturer	Beech Aircraft Corporation
Designed by	Burt Rutan
First flight	15 February 1986
Number built	53
Unit cost	US$3.9 million

Contents

- 1 Development
- 2 Design
- 3 Operational history
  - 3.1 Sales
  - 3.2 End of the program
- 4 Specifications (2000A)
- 5 See also
- 6 References
- 7 External links

Att mt
3B

Development

Work began in 1979 when Beechcraft identified a need to replace the King Air 200 model. After a brief hiatus while the company was being bought by Raytheon, full development began in 1982 when Beechcraft approached Burt Rutan of Scaled Composites, a leader in the field of novel composite aircraft design. Much of the design work utilised computer-aided design, using the CATIA system.

While in development at Scaled Composites, the 85%-scale prototype was the **Model 115**, and Beechcraft referred to the production version as the **Model 2000**. The Model 115 first flew in late August 1983. However, this aircraft had no pressurization system, no certified avionics, and a different airframe design and material specifications than the planned production Model 2000. Only one Model 115 was built, and it has since been scrapped.

The first full-size Starship (the Model 2000) flew on February 15, 1986. Prototypes were produced even as development work was continuing — a system demanded by the use of composite materials, as the tooling required is very expensive and has to be built for production use from the outset. The program was delayed several times, at first due to underestimating the development complexity involved and later to overcome technical difficulties concerning the stall-warning system.

The first production Starship flew in late 1988, after over $300 million in development costs. Those working in the program have stated that much of the development delay was due to the new owners' ongoing vacillation and lack of assurance over whether to continue with the new-concept project.

Design

The Starship was notable for several reasons:

- Its all-graphite composite airframe, using high-tech materials instead of aluminum. These materials were in frequent use to varying degrees on military aircraft, but no civilian aircraft certified by the US Federal Aviation Administration had ever used them so extensively. Composites were chosen to reduce the weight of the aircraft and to provide exceptional surface smoothness. However, the empty weight of production aircraft considerably exceeded the target.

- Its canard design, with the lifting surface aft of the horizontal stabilizer. As configured, the Starship cannot be stalled - the forward surface stalls before the main lifting surface, which allows the nose to drop and more-normal flight to resume.

- Its lack of a conventional centrally placed vertical tail. Its two vertical surfaces are mounted at the tips of the swept wings, which places the rudders well aft of the aircraft's center of gravity.

- Its pusher design, with the turboprop engines mounted facing the rear, pushing rather than pulling the aircraft. This design has the potential of a quieter ride, since the propellers are far removed from the passengers and because vortices from the propeller tips do not strike the fuselage sides. However, the propellers are operating in a turbulent airflow in the pusher configuration (due to airflow past the wings moving aft in vortex sheets), and thus the resulting propeller noise is more choppy and raucous than otherwise.

- Flight instrumentation for the Starship included a 16-tube Proline 4 AMS-850 "glass cockpit" supplied by Rockwell Collins, an early application of this concept in small civil aircraft.

Operational history

Sales

Commercially, the aircraft was a failure, with little demand. Only fifty-three Starships were ever built, and of those only a handful were sold. Many of the aircraft were eventually leased by Raytheon, which allowed the company to control their distribution and operational life. Raytheon considered the cost of supporting a commercial fleet of just 53 aircraft with necessary parts and flight training to be prohibitive. Leasing the aircraft allowed Raytheon to effectively recall and ground most of the fleet at the end of their initial leases.


Beechcraft Starship

Some reasons for the lack of demand:

- Price. 1989 list price for a Starship was $3.9 million, similar to the Cessna Citation and Learjet 31, which were pure jets of similar carrying capacity and range. The Piper Cheyenne, a turboprop airplane of similar capacity, was less expensive ($2.9 million).[1]
- Performance. The Starship was 89 knots (165 km/h) slower than the Cessna Citation. It was 124 knots (230 km/h) slower than the Learjet 31. The turboprop-powered Piper Cheyenne was also faster than the Starship. The turboprop-powered Italian Piaggio P.180 Avanti had a configuration somewhat similar to the Starship (it incorporated a canard as well as a conventional tailplane) and comparable capacity, but was faster.
- Economic conditions. The Starship was finally introduced as the US economy was entering a periodic slowdown, and sales of all high-ticket items such as business transportation vehicles were off.
- Undesirable characteristics. Several pilots who tried flying the Starship noted its significant phugoid tendency, in which the nose continually rises and falls during otherwise level flight, as if "hunting" for the correct flight attitude.

End of the program

In 2003, Beechcraft deemed that the aircraft was no longer popular enough to justify its support costs, and has recalled all leased aircraft for scrapping. The company was also said to be buying back privately-owned Starships, though some Starship owners say they have never been contacted by Raytheon about this. Raytheon's spin-off, *Hawker Beech Corporation*, continues to offer technical support by phone but no longer offers parts support to current Starship operators. Rockwell Collins has maintained full support for the AMS-850 avionics suite. In March 2008, the third of the five remaining Starships completed RVSM certification returning the aircraft's service ceiling to the original FL410 limit.

Almost all of the recalled Starships have been ground up and incinerated at the "boneyard" at the Evergreen Air Center (http://www.evergreenac.com/about.html) located at the Pinal Airpark in Arizona. The planes have little aluminum for recycling. A few have been purchased by individuals who regard them as lovable failures, much like the infamous Ford Edsel. Starship Model 2000A NC-51 was used as a chase plane during the re-entry phase of Burt Rutan's SpaceShipOne. Several Starships have been donated to museums since the decommissioning program began, with the Kansas Aviation Museum receiving the first aircraft in August 2003. Starship NC-42, flown by the architect David Schwarz for many years, is now at the Museum of Flight in Everett, Washington. Starship N214JB is displayed at the Southern Museum of Flight adjacent to the Birmingham International Airport in Alabama.

As of autumn 2008 only six Starships continue to hold airworthiness registration with the FAA. Three Starships are based in Oklahoma, one in Washington, one in California, and one is still registered to Raytheon Aircraft Credit Corporation in Wichita, Kansas.

Specifications (2000A)

Data from Beechcraft Starship 2000A Performance, Specifications & Equipment[2]

A Beechcraft Starship chasing a Scaled Composites SpaceShipOne during a test flight

General characteristics

- **Crew:** one or two pilots
- **Capacity:** 8 passengers
- **Length:** 46 ft 1 in (14.05 m)
- **Wingspan:** 54 ft 4.7 in (16.58 m)
- **Height:** 12 ft 11 in (3.94 m)
- **Wing area:** 280.88 ft² (26.1 m²)
- **Empty weight:** 10,120 lb (4,590 kg)
- **Loaded weight:** 15,010 lb (6,823 kg)
- **Max takeoff weight:** 14,900 lb (6,760 kg)
- **Powerplant:** 2× Pratt & Whitney Canada PT6A-67A Turbo-props, 1,200 shp (895 kW) each
- **Propellers:** 5-bladed McCauley propeller

Performance

- **Maximum speed:** 335 knots .60 mach (385 mph, 620 km/h)
- **Stall speed:** Un-stallable (Un-spinable)
- **Range:** 1,576 nm (1,814 mi, 2,920 km)
- **Service ceiling:** 41,000 ft (12,500 m)
- **Rate of climb:** 2,748 ft/min (13.96 m/s)
- **Wing loading:** 53.0 lb/ft² (258.77 kg/m²)
- **Power/mass:** 6.21 lb/shp (3.78 kg/kW)

See also

Comparable aircraft

- AASI Jetcruzer
- Piaggio P.180 Avanti

References

1. ^ *Aviation Week & Space Technology*. October 2, 1989.
2. ^ "Beechcraft Starship 2000A Performance, Specifications & Equipment" (http://www.starshipdiaries.com/specifications.html). http://www.starshipdiaries.com/specifications.html.

External links

- The Starship Diaries (http://www.starshipdiaries.com/starship.html)
- A Collection of Beechcraft Starship 2000A Material (http://www.bobscherer.com/Pages/Starship.htm)

Retrieved from "http://en.wikipedia.org/wiki/Beechcraft_Starship"
Categories: Canard aircraft | United States civil utility aircraft 1980-1989
Hidden categories: All articles with unsourced statements | Articles with unsourced statements since September 2008 | Pusher aircraft

Royce Carlton
INCORPORATED
Agents, Managers and Brokers for Speakers

866 United Nations Plaza • New York, NY 10017 • 212.355.7700

Return Print Email

Burt Rutan
Aerospace Engineer, *SpaceShipOne* • CEO, Scaled Composites

See last page

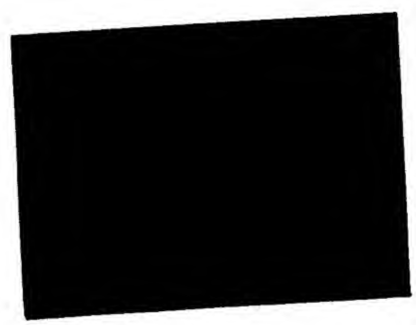
Curriculum Vitae

EDUCATION

1. B.S. Aeronautical Engineering, California Polytechnic University, 1961-1965. Third in graduating class.
2. Space Technology Institute, California Institute of Technology, 1964.
3. Marketing and Personnel Management graduate level courses, Golden Gate College, 1968-1969.
4. Academic portion of Aerospace Research Pilots School, Edwards AFB, 1965.
5. Doctoral of Science, honoris causa, Daniel Webster College, 17 May 1987.
6. Honorary Doctor of Science, California Polytechnic University, San Luis Obispo, 13 June 1987.
7. Doctoral of Humanities, honoris causa, Lewis University, 22 May 1988.
8. Doctoral of Technology, honoris causa, Delft University of Technology, 12 January 1990.
9. Doctoral of Engineering, honoris causa, University of Illinois, June 2006.

PROFESSIONAL ORGANIZATIONS

1. Experimental Aircraft Association
2. Society of Experimental Test Pilots
3. Amer. Inst. Aeronautics & Astronautics
4. Society of Flight Test Engineers
5. Academy of Model Aeronautics
6. International Order of Characters
7. Aircraft Owners and Pilots Assn.
8. National Academy of Engineering



BURT RUTAN'S COMPANIES:

Scaled Composites - April 1982 to present:
In April 1982, Mr. Rutan founded Scaled Composites Incorporated to develop research aircraft. The company employs 130 people in four flight line buildings located on the Mojave Airport. Most of the projects done by Scaled are proprietary to the customer; therefore the facility is closed to the public. A list showing many of Scaled's major projects follows:

- A single-place, twin-jet research aircraft for Fairchild Republic Company (the subscale T-46A demonstrator).

- A two-place, single-engine recreational aircraft for Group Lotus, Ltd. the Microlight POC.
- A twin-turboprop high-performance business aircraft, the sub-scale Starship I POC for customer Beechcraft.
- A large agricultural aircraft, Predator POC.
- The CM-44 POC reconnaissance aircraft.
- A tandem-wing, three-surface technology demonstration aircraft for DARPA (the Advanced Technology Tactical Transport-62% scale ATTT POC).
- Prototypes and the first production run (28 vehicles) of an all-composite remotely-piloted reconnaissance vehicle, the Teledyne Ryan Aeronautical Model 324 Scarab.
- An 85-foot and 108-foot span rigid sail/airfoil for the America's Cup Challenge Race.
- The Triumph, an all-composite cabin-class twin jet aircraft for Beechcraft.
- The ARES, an all-composite single-seat jet attack aircraft, designed for anti-helicopter, close air support, reconnaissance, training, and other missions.
- The Pond Racer, and entry into the piston-powered unlimited category aircraft racing arena.
- The Orbital Sciences Pegasus rocket wing, fillets and fins (structural design, tooling, and manufacture of more than 40 ship-sets).
- The Earthwinds gondola for a global nonstop balloon record attempt.
- The McDonnell-Douglas DCX, Single Stage Rocket Technology (SSRT) 1/3 scale proof-of-concept demonstrator vehicle.
- Two Bell Helicopter Eagle Eye unmanned tilt-rotor aerial vehicle demonstrators.
- The VisionAire Business Jet demonstrator.
- Three NASA X-38 Crew Return Vehicles for subsonic flight testing.
- Nine 20 meter wind turbine blades for Zond.
- An all-new wing for the Israeli Aircraft Industries (IAI) Pioneer RPV, later renamed the Searcher.
- The all-composite main landing gear beam for the twin-engine IAI Hunter RPV.
- The primary and secondary structure for a General Motors (GM) technology demonstration vehicle, the GM Ultralite concept car.
- The Raptor high altitude UAV, developed for the NASA ERAST program.
- The POC VisionAire Vantage single engine business jet.
- The Williams International V-Jet II.
- The ROTON ATV SSTO Atmospheric Test Vehicle).
- The Proteus high-altitude long-endurance aircraft, developed for Wyman-Gordon, first flew in 1998, and set world's altitude records by flying over 63,000 feet. The aircraft has logged over 1500 hours, flying science missions to destinations including Europe, Japan and the North Pole.
- The Adam Model 309 POC aircraft, an all-composite, twin engine, centerline thrust aircraft. It is seeking FAA certification in 2005.
- Scaled's first project for manned space flight includes a new hybrid rocket engine, the White Knight (an airborne launch aircraft) and SpaceShipOne (a three-place, high-altitude research rocket). Sponsor for the program is Paul Allen. On 21 June 2004, with Mike Melvill at the controls, SS1 flew history's-first private manned space flight. On 4 Oct 2004, SS1 won the 10 M$ X-prize (two flights within 5 days flown by Melvill and Brian Binnie).
- In 2004, Scaled performed the first flight of the second aircraft designed to fly non-refueled around the world. The Capricorn, built for Steve Fossett, was later named the GlobalFlyer, by sponsor Virgin Atlantic. The aircraft is expected to fly the solo record world flight in January 2005.

In June 1985, Scaled was sold to Beech Aircraft Corporation, acquired by Wyman-Gordon Company

in January 1989, and then sold to 10 private investors in September 2000 (Scaled Composites LLC). Mr. Rutan has been President/CEO since its formation in 1982.

RAF - June 1974 to present:

President of Rutan Aircraft Factory Inc. (RAF), a small business formed to develop light aircraft and market educational documents. Developed the VariViggen, VariEze, NASA AD-1, Quickie, Defiant, Long-EZ, Grizzly, scaled NGT Trainer, Solitaire, Catbird and the world-flight Voyager aircraft. Activities performed in the development of these aircraft covered the entire spectrum, from design through flight test, test report and documentation preparation, public relations and management of development facility. RAF provides builder support for over 3000 homebuilder customers. Homebuilt aircraft plans sales were discontinued in July 1985.

OTHER EMPLOYMENT BY BURT RUTAN:

March 1972 to May 1974: Director of the Bede Test Center, Bede Aircraft, Newton, Kansas. Directed development of three aircraft types including all flight and ground tests. Had design and development responsibility for the jet BD-J5 and trainer-simulator.

June 1965 to March 1972: US Air Force Government employee. Flight Test Project Engineer at the Air Force Flight Test Center, Edwards AFB. Conducted fifteen USAF flight test programs, ranging from large V/STOL cargo aircraft to several types of fighters.

PILOT EXPERIENCE

1. Began flying in 1959. General aviation pilot time in the following aircraft:

Beech T-34	Headwind
Beech Bonanza	Beech Model 76 (Duchess
Beech Musketeer	Spirit of St. Louis Replica
Cessna 150, 172, 182, 210	Beech Travelair
Piper Cherokee 140, 180	Beech 58P pressurized Baron
Piper Arrow	B200 Super King Air
Piper J-3	B300 Super King Air
Piper PA18-150S Seaplane	VariViggen*
Aeronca Champ 7AC	VariEze*
Taylor L-2	VariEze POC*
American Yankee	Quickie*
American Traveler	Defiant*
Grumman Tiger AA5B	Long-EZ
Grumman Widgeon	Scaled NGT twin jet trainer
Ercoupe	Microstar twin jet VariViggen
Thorpe T-18	Beech 85% scale Starship
Luscombe 8A	M120 Predator
BD-4	CM-44 UAV
BD-5	Microlight Model 97
BD-5T	M133 ATTT assault transport prototype
BD-6	M81 Catbird

RF5-D	M143 Triumph cabin class twin turbofan
Ayers Thrush 600	T-34C
Piper Turbo Apache	Pitts S1
Robinson R22	Bell UH1D
Hughes 300	M151 ARES turbofan attack prototype
Hughes 500E	Enstrom F280
Robin ATL	Model 191
Model 202 Boomerang*	

*Flew first flight of type and most of the research test program.

- USAF Co-pilot time in the following military aircraft, mostly during hazardous tests:

UH-IN	F-104A and B	C-130E
T-33	F-4B, C, E & Agile Eagle	C-141A
T-37	YA-26	F-106
T-38		

Total flying time 3000 hours. FAA ratings: Private, single engine land, multi-engine land, single engine sea, instrument airplane, single engine helicopter.

MAJOR NON-PROPRIETARY PROJECTS DEVELOPED

MODEL	NAME	CUSTOMER	FIRST FLIGHT DATE	FABRICATION SHOP	DESCRIPTION
27	VariViggen	homebuilders	May 72	Rutan Aircraft Factory	canard pusher, 2-place, single engine, wood construction
31	VariEze Prototype	R&D	May 75	Rutan Aircraft Factory	high efficiency, loaded canard, all composite, Volkswagen engine
32	VariViggen SP	homebuilders	Jul 75	Rutan Aircraft Factory	Model 27 with added higher aspect ratio composite wings
33	VariEze	homebuilders	Mar 76	Rutan Aircraft Factory	homebuilt version of Model 31, larger, with aircraft engine
35	AD-1	NASA	Nov 79	Ames Industrial	skew wing, all composite twin turbojet
40	Defiant	homebuilders	Jun 78	Rutan Aircraft Factory	tandem wing, all composite, twin engine, four-place

54	Quickie	homebuilders	Nov 77	Rutan Aircraft Factory	single place, tandem wing, all composite, Onan engine
54	Quickie	homebuilders	Nov 77	Rutan Aircraft Factory	single place, tandem wing, all composite, Onan engine
61	Long-EZ	homebuilders	Jun 79	Rutan Aircraft Factory	high efficiency, long range, loaded canard, all composite, single engine
68	Biplane Racer	Mortensen/Amsoil	Aug 81	Customer	all composite, tandem wing for air racing in biplane class
72	Grizzly	R&D	Jan 82	Rutan Aircraft Factory	three surface, STOL, 4-place, all composite, for off-field operation
73	Next Generation Trainer	Fairchild Republic	Sep 81	Ames Industrial	subscale demonstrator to develop flying qualities for T-46 proposal
76	Voyager	Voyager Aircraft	Jun 84	Rutan Aircraft Factory	all graphite, optimized for long-range records, two pilot, twin engine
77	Solitaire	homebuilders	Jun 82	Rutan Aircraft Factory	self launching sail plane
--	PARLC	United States Navy	Sep 80	Ames Industrial	power augmented ram landing craft, twin turbojet
81	Catbird	R&D	Jan 88	RAF/Scaled	single engine turbocharged recip, 5-place pressurized 3 -surface configuration
97	Microlight	Lotus/Chapman	Jan 83	Scaled Composites	two-place, rigid ultralight pusher, canard, all composite
115	NGBA(Starship POC)	Beech Aircraft	Aug 83	Scaled Composites	variable geometry, twin turboprop, 85% scale of Starship design
120	Predator	Advanced Tech. Aircraft Corp.	Sep 84	Scaled Composites	all composite, agricultural application, 80 cubic foot hopper
133	ATTT	DARPA	Dec 87	Scaled Composites	twin turboprop assault transport, fast-acting flaps, 3-surface configuration
143	Triumph	Speculative	Jul 88	Scaled Composites	twin turbofan 7-place business aircraft, Williams FJ-44 engines
144	CM-44 UAV	California Microwave, Inc.	Mar 87	Scaled Composites	composite manned/unmanned, long endurance, canard,

					single pusher turbocharged engine
TRA 324	Scarab	Teledyne Ryan Aeronautical	Jun 86	Scaled Composites	ground launched high-performance reconnaissance drone, solid rocket + turbojet. Scaled conducted structure only development/production.
H1, H2	Wing Sail	Sail America	May 88	Scaled Composites	graphite wing sails for America's Cup Race, 90 and 108 ft span
--	Searcher	Israeli Aircraft Industries	Dec 88	Scaled Composites	long wing version of Pioneer RPV
151	ARES	Speculative	Feb 90	Scaled Composites	light attack turbofan, close air support aircraft, high agility, JT15D engine, GAU-12U gun
158	Pond Racer	Bob Pond	Mar 91	Scaled Composites	
173	TFV	Loral	Jul 89	Scaled Composites	towed vehicle for decoy - model tests
179	PLADS/Rockbox	Lockheed	Nov 89	Scaled Composites	eight man parachute delivery vehicle
--	Gondola	Earthwinds	Nov 91	Scaled Composites	pressurized gondola for world balloon flight
--	Pegasus flying surfaces	Orbital Sciences Corporation	Apr 90	Scaled Composites	air launch vehicle flying surfaces (wing, fins)
191	Model 191	Proprietary	Oct 91	Scaled Composites	single engine general aviation aircraft
--	B-2 RCS model	Northrop Corp.	--	Scaled Composites	40% scale pole model
--	SU25 1/4 scale ROAR	Sandia National Laboratories	Apr 91	Scaled Composites	rocket powered cable-mounted decoy
--	Ultralite show car	General Motors	Jan 92	Scaled Composites	4 passenger, 4 door show car for 1992
--	Eagle Eye	Bell Helicopter	--	Scaled Composites	tilt-rotor demonstrator aircraft
--	DC-X	McDonnell Douglas	--	Scaled Composites	30% scale single stage rocket technology aeroshell
202	Boomerang	IR&D	Jun 96	Rutan Designs	asymmetrical configuration 5-place pressurized reciprocating twin
226	Raptor D1	Department of Energy	Apr 93	Scaled Composites	high altitude RPV boost phase intercept
226	Raptor D-2 ERAST	DOE/NASA	Dec 94	Scaled Composites	high altitude RPV for environmental research

--	Vantage	Proprietary	Aug 93	Scaled Composites	FJ107 powered Long-EZ
--	Z-40 Bladerunner	Zond	Apr 94	Scaled Composites	blades for large wind generator
--	Comet	Space Industries	95	Scaled Composites	all composite spacecraft unmanned re-entry capsule
233	Freewing Full Scale	Freewing Aircraft	Oct 94	Scaled Composites	close range, super STOL RPV
--	Kistler Zero	Kistler Aerospace	--	Scaled Composites	two stage demonstration rocket - canceled mid "95
247	Vantage	VisionAire Corporation	Nov 96	Scaled Composites	single engine turbofan 7-place business aircraft with JT15D-5 engine
257	Motel 6 DLS	Voyager Aircraft	Jan 98	Scaled Composites	pressurized spherical gondola for manned world balloon flight
271	V-Jet II Spike	Williams, Intl.	Apr 97	Scaled Composites	twin turbofan 5 place pressurized
276	X-38 space station lifeboat	NASA	Mar 98	Scaled Composites	crew rescue vehicle for space station Three were built for Dryden & Johnson
281	Wyman-Gordon	Proteus	July 26, 1998	Scaled Composites	turbofan high flyer for telecom/recon/ atmospheric science/space tourism
287	Alliance high flyer UAV	NASA ERAST		Scaled Composites	85,000 ft environmental research UAV R/C model tested to prove concept
302	TAA-1	Toyota Aircraft	May 31, 2002	Scaled Composites	4 place GA piston single
309	Adam Model 309	Adam Aircraft	Mar 00	Scaled Composites	twin turbocharged twin boom, push-pull 6 place business/personal aircraft
311	Capricorn GlobalFlyer	Steve Fossett Virgin Atlantic	Mar 5, 2004	Scaled Composites	Non-refueled, round-the-world range Single-pilot, turbofan. Fuel/GW = .82
316	SpaceShipOne	Mojave Aerospace Ventures	Aug. 7, 2003	Scaled Composites	three-place, high-altitude research rocket First private manned space flight 21Jun04
318	White Knight	Mojave Aerospace Ventures	Aug. 1, 2002	Scaled Composites	high-altitude, airborne launch aircraft
					UAV single turbo fan LO

326	Pegasus X-47A	Northrop Grumman	July 27, 2001	Scaled Composites	UAV for carrier suitability evaluation

PRESENTATIONS

1. AIAA Student Conference, 1965, "An Investigation of the Effect of Aileron Differential on Roll-Yaw Coupling During an Abrupt Aileron Roll." Project used an instrumented radio controlled model developed while in school.
2. Society of Experimental Test Pilots Symposium, 1967, "Development of a Heavyweight Low Level Aerial Delivery Capability."
3. Society of Experimental Test Pilots Symposium, 1970. "Fighter Testing - Spin Test or Spin Prevention Test?"
4. Canadian Aeronautics and Space Institute, Flight Test Certification Symposium, 1971, "Spin Testing for Certification -- Our Failures."
5. Society of Experimental Test Pilots Symposium, 1975. "Development Tests of a High Aspect Ratio, Canard-Type Light Plane."
6. Aviation/Space Writers Association 43rd Annual News Conference, 1981. "Challenge to General Aviation."
7. National Air and Space Museum Lindbergh Lecture, 1982. "Aircraft Design - A Blend of Science and Art."
8. Society of Experimental Test Pilots Symposium, 1984, "Use of the Proof-of-Concept Demonstrator for Aerodynamic Development."
9. Society of Experimental Test Pilots Symposium, 1987. "The Voyager Story."
10. California Polytechnic University at San Luis Obispo, Opening Ceremonies of Poly Royal, 22 Apr 87.
11. California Polytechnic University at San Luis Obispo, Commencement Address, 13 Jun 87.
12. Distinguished Lecture Series, WestPoint Academy, 17 February 1988.
13. Los Angeles Air Force Base, Space Division, "Acquisition Streamlining," 13 Oct 88.
14. AGARD Conference '88 at Edwards Air Force Base, "Low Cost POC Flight Testing," 19 Oct 88.
15. U.S. Department of Defense Acquisition Streamlining Conference, "R & D Acquisition, A System in Turmoil," 1 Jun 89.
16. National Academy of Sciences Rapid Prototyping Conference, "Prototype R & D - A Revolutionary Approach," 20 Jun 89.
17. National Research Council Committee on Ultralight Structures, "Fire the Concept Design Group," 14 Sep 89.
18. Leroy Randle Grumman Lecture Series, "Prototype R & D: A Revolutionary Approach," 4 Oct 89.
19. Defense Systems Management College, "Acquisition Streamlining," 21 May 90.
20. General Motors Design Center, "Rapid Prototyping," 22 May 90.
21. Paris Air Show for Dupont and Aerospatiale "Structural Seminar," 20 June 1991.
22. Eris Society, Aspen, CO - "Life, the Universe and Everything Else...," 5 Aug 92.
23. University of Kentucky Transportation Conference - Keynote Speaker "Future of Transportation," 29 Sep 92.
24. Society of Experimental Test Pilots Symposium, Beverly Hills, CA, "Flight Test Development

of a New Generic Configuration -- The Boomerang," Sep 96

25. Georgia Institute of Technology, Harold W. Guggenheim Lecture Series on Innovation (second annual) - "Innovation: Use It or Lose It," Dec 96
26. More than 50 technical Presentations on the Voyager aircraft, "Small Team, Giant Challenge" 1987-Current.
27. Experimental Aircraft Association Convention, 1973 through current. More than 100 presentations on development of RAF aircraft and aerodynamics lectures.

AWARDS

1. First Place National Student Undergraduate Award AIAA, 1965.
2. Air Medal (rare award for civilian), 1970.
3. Stan Dzik Design Contribution Trophy, 1972.
4. Omni Aviation Safety Trophy, 1973.
5. EAA Outstanding New Design, 1975, 1976 and 1978.
6. Dr. August Raspet Memorial Award, "Outstanding Contribution to the Advancement of Light Aircraft Design," 1976
7. Flying/Business and Commercial Aviation, 1978. Special Award "For a Lifetime Involvement in, Service to and Support of General Aviation."
8. Western Plastics Exposition, "Pacesetter Award," 1978.
9. Press Club of Antelope Valley, "Newsmaker of the Year," 1980.
10. Aviation Week and Space Technology magazine, Special Achievement - Laurels for 1981, for "Imaginative Ideas for Light, Energy-Efficient Aircraft Design."
11. Business and Commercial Aviation magazine, "Most Important Contribution to Aviation during 1984."
12. ABC World News Tonight, "Person of the Week," July 18, 1986.
13. American Institute of Aeronautics and Astronautics, Aircraft Design Certificate of Merit for initiative and creativity in the development of the Starship and Voyager aircraft, October 1986.
14. Presidential Citizen's Medal presented by Ronald Reagan, December 29, 1986 for Mr. Rutan's design/development of the Voyager 'round-the-world aircraft. This was the 18th award of the Presidential Citizen's Medal since its inception in 1969.
15. FAI Gold Medal for Voyager Construction, 29 Jan 87.
16. "Grand Medaille" de'Aero-Club de France, (Grand Medal of the Aero Club of France), January 29, 1987.
17. Medal of the City of Paris, January 29, 1987.
18. The Aero Club of Washington, 1986 Aviation Achievement Award, 24 February 1987.
19. NASA Langley Research Center, Directors Award, 24 Feb 87.
20. Society of Plastics Engineers, Award for Unique and Useful Plastic Product, (Voyager), 7 May 1987.
21. Society of Plastics Industry, Special Achievement Award for the Advancement of Composites for the Voyager Flight, 9 May 1987.
22. Society of NASA Flight Surgeons, W. Randolph Lovelace Award, 13 May 87.

23. Academy of Model Aeronautics, Distinguished Service Award, 15 May 1987.
24. National Aeronautic Association and the National Aviation Club, 1987 Collier Trophy for ingenious design and development of the Voyager and skillful execution of the first non-stop, non-refueled flight around the world, 15 May 1987.
25. Aero Club of New England, Voyager Award, 25 Jun 87.
26. American Academy of Achievement, Golden Plate to America's Captains of Achievement, 27 Jun 87.
27. Experimental Aircraft Association and Milwaukee School of Engineering, Medal of Outstanding Achievement and Distinguished Leadership in Aerospace Engineering, 4 Aug 87.
28. Daedalians of Edwards Air Force Base, Citation of Honor, 15 Aug 87.
29. Society of Experimental Test Pilots, 1987 J. H. Doolittle Award for outstanding professional accomplishment in aerospace technology management of engineering, September 1987.
30. Gathering of Eagles, Aviation Man of the Year, 17 Sep 87.
31. Charles Lindbergh Fund - San Diego Museum, Lindbergh Eagle Award, 24 Sep 87.
32. National Business Aircraft Association, Meritorious Service Award for 1987, 29 Sep 87.
33. United States Air Force Association, United States Air Force 40th Anniversary Award for Extraordinary Achievement, 1987.
34. The City of Genoa, Italy, Christopher Columbus International Communications Medal, 12 Oct 87.
35. Distinguished Achievement Award, International Aerospace Hall of Fame, San Diego, 7 Nov 87.
36. American Society of Mechanical Engineers, Spirit of St. Louis Medal, 16 Dec 87.
37. Royal Aeronautical Society, British Gold Medal for Aeronautics awarded for outstanding practical achievement leading to advancement in aeronautics for his original conception and successful design and development of the Voyager aircraft, December 1987.
38. The National Society of Professional Engineers, Outstanding Engineering Achievement in the NSPE 22nd Annual Outstanding Engineering Achievement Awards Competition, 27 Jan 1988.
39. Design News "Engineer of the Year for 1988," 8 March 1988.
40. Franklin Institute, Franklin Medal for 1987, 13 April 1988.
41. Intellectual Property Owners, Distinguished Inventor Award for 1987, 14 April 1988.
42. Western Reserve Aviation Hall of Fame, Meritorious Service Award, 2 Sep 1988.
43. The International Aerospace Hall of Fame Honoree, 24 Sep 1988.
44. Sailing World Magazine, Medal of Achievement, January 1989.
45. Aero Club of Northern California, Crystal Eagle Award, 18 Mar 1989.
46. Secretary of the Air Force Meritorious Civilian Service Medal for service on the USAF Scientific Advisory Board, April 1989.
47. Member of the National Academy of Engineering, 4 Oct 1989.
48. Leroy Randle Grumman Medal for outstanding scientific achievement 4 Oct 1989.
49. Structural Dynamics and Materials Award from American Institute of Aeronautics and Astronautics, presented "for innovative and outstanding contributions to the advancement of aerospace technologies, including the design, development and testing of light-weight, high performance composite structures materials," 14 April 1992.
50. Wings Over Houston Airshow Executive Committee, 1993 Lloyd P. Nolen Lifetime

Achievement in Aviation Award, 16 Oct 1993.

51. Society for the Advancement of Materials and Process Engineering George Lubin Award, 9 May 1995.
52. National Aviation Hall of Fame Honoree, 21 July 1995.
53. "Freedom of Flight" award for "contributions to EAA and to aviation, especially for his leadership in the design of recreational aircraft--including Voyager--that have had an impact on the international aviation community", Experimental Aircraft Association, 3 August 1996.
54. College of Engineering Medallion "in recognition of extraordinary leadership and commitment in support of the Aeronautical Engineering Department," April 18, 1997, The College of Engineering at Cal Poly, San Luis Obispo
55. Chrysler Award for Innovation in Design, 1 October 1997
56. EAA Homebuilders Hall of Fame, 23 October 1998
57. Designer of the Year, Professional Pilot Magazine, 13 March 1999
58. Proteus Aircraft included in the list of the "100 Best of the Century", Time Magazine, April 1999
59. Clarence L. "Kelly" Johnson "Skunk Works" award by the Engineers Council "to honor and perpetuate Kelly Johnson's qualities, accomplishments, standards and model of excellence to be aspired to by future generations of engineers, pioneering progress of the future." February 2000
60. 2000 Lindbergh Award presented by the Lindbergh Foundation for a shared vision of a balance between technological advancement and environmental preservation. May 20, 2000.
61. The 2001 J.H. "Jud" Hall Composites Manufacturing Award presented by the Composites Manufacturing Association of the Society of Manufacturing Engineers for his "contribution to the composites manufacturing profession through leadership, technical developments, patents and/or educational activities", 22 Feb 2001
62. The Reed Aeronautics Award presented by the American Institute of Aeronautics and Astronautics "in recognition of significant contributions and achievements in the field of aeronautical sciences and engineering, as an engineer, designer and builder of aircraft that challenge conventional wisdom, thus opening the door for innovation in aircraft prototyping and stimulation of new ideas and applications to further aerospace endeavors, May 9, 2001.
63. Laurel Legend Award presented by Aviation Week & Space Technology. Received award and was inducted into the Aviation Week & Space Technology Hall of Fame, April 16, 2002.
64. "100 Stars of Aerospace" (ranked 29th) presented by Aviation Week & Space Technology. Received award in Paris at Salle Wagram, June 18, 2003.
65. "Business Leader in Aerospace" presented by Scientific American for designing a reusable sub-orbital passenger spacecraft. One of 50 individuals, teams or companies whose accomplishments in research, business or policy making during 2002-2003 demonstrate outstanding technological leadership, November 10, 2003.
66. Society of Experimental Test Pilots, "2004 J. H. Doolittle Award for outstanding professional accomplishment in aerospace technology management of engineering," September 2004. First to receive the Doolittle twice.
67. X Prize (Shared with Paul Allen). For repeated private manned space flights. 4 October 2004.
68. Wired Magazine's "Rave Award" for Industrial Designer Burt Rutan, 22 Feb. 2005.
69. Smithsonian's National Air and Space Museum's "Current Achievement Award", 9 March 2005
70. Aviation Week and Space Technology 2004 Laurel Award for Innovation/Entrepreneurship,

19 March 2005.

71. "Scientist of the Year" award by Achievement Rewards for College Scientists (ARCS), 15 April 2005.
72. Time Magazine's "100 Most Influential People in the World," 18 April 2005.
73. "2004 Robert J. Collier Trophy" - presented by National Aeronautic Administration, 19 April 2005. (This is the second Collier Trophy awarded to Mr. Rutan.)

PATENTS HELD

1. Grizzly wide-chord flap suspension system, U.S. Patent Number 4,614,320.
2. Variable geometry high lift system incorporated in the Beech Starship, U.S. Patent Number 4,641,800. (Foreign patents also held.)
3. Rutan Model 115 Starship configuration, U.S. Patent Number Des. 292,393. (Foreign patents also held.)
4. U.S. Provisional Patent Application 60/458,296, filed March 28, 2003.
5. U.S. Provisional Patent Application 60/458,697, filed March 28, 2003.
6. Patent Cooperation Treaty Application PCT/US2004/009694, entitled "Unitized Hybrid Rocket System," filed March 29, 2004, claiming the benefit of the provisional patent application described in Item 4 above.
7. Patent Cooperation Treaty Application PCT/US2004/009695, entitled "Winged Spacecraft," filed March 29, 2004, claiming the benefit of the provisional patent application described in Item 5 above.

As of April 2005

[redacted]

View Full Version : a 250 Knot Long EZ

airwrench [redacted]04-2006, 05:27 PM

I am finishing up the initial stages of my long ez project. I have the bulkheads complete and waiting on the sticks for the fuse. I am interested in speed mods in an effort to acheive a moderately fast aircraft capable of withstanding cruising speeds in excess of 250kts. (the engine part is simple, I just want to know what structural mods would be prudent to implement in regards to the increased speed)..............waited too long for the infinity, which don't seem to be getting off the ground:(

Richard Riley 03-08-2006, 12:07 AM

Yeah, the engine part is simple - just get an IO 540. Extend the fuselage a foot and move the pilot and passenger forward. Make the wingskins and spar caps out of carbon. Be sure to use a good pair of wheel pants and gear leg fairings.

magnum 03-08-2006, 03:29 PM

Newbie question here!
I am about to start my Long / Berkut project and am after basically the same thing. Speed! Could you also substitute the cozy wings and spar (since this is all new construction) and make the spar to the EZ dimensions and then carbon both? Would this change a lot or be more stabil in flight than the Long EZ wings?
Just curious (and now putting on fire suit):scared:
Press On
Tom

Spodman 03-08-2006, 05:45 PM

Your questions are beyond my technical expertise, but I don't have a lot of faith in the above ideas either. I am not aware of any evidence there is anything deficient in the strength of the airframe or that this is the speed limiting factor. There are plenty of fast aircraft out there all fg. I am not convinced substituting cf for fg will (by itself) create a stronger structure.

I do understand the limiting factors are airframe flutter and performance of the canard. These problems may be overcome by re-design. Don't know how to go about it.

Remember this is a very efficient cross-country touring aircraft you are considering hot-rodding. On completion you will not have a particularly useful aircraft.

satch 03-08-2006, 08:28 PM

Yeah, the engine part is simple - just get an IO 540. Extend the fuselage a foot and move the pilot and passenger forward. Make the wingskins and spar caps out of carbon. Be sure to use a good pair of wheel pants and gear leg fairings.

Gee ... sounds like a Berkut FG :-)

Jack Morrison 03-08-2006, 11:54 PM

Add a little width, round the fuselage and bingo.

Jack
E Racer 113

airwrench 03-09-2006, 04:39 PM

:D Add a little width, round the fuselage and bingo.

Jack
E Racer 113 I Got that

R.D."Rick" Talbot 03-18-2006, 11:06 PM

I'm new to your organization but has anyone considered the Innodyn 255 hp turbine at 188 lbs instead of the IO-540 hp at 390 lbs ?

Richard Riley 03-18-2006, 11:11 PM

I'm new to your organization but has anyone considered the Innodyn 255 hp turbine at 188 lbs instead of the IO-540 hp at 390 lbs ?

I'll be happy to consider it when Innodyn delivers their first engine.

That would be sometime after the sun goes dark.

If you want to talk about a turbine engine that actually exists, we could talk about a 250 C-18. There's a guy that's just put one on a Cozy, with a custom gearbox. Very interesting. Or there's the Deltahawk, which has a good shot at delivering a batch of engines to it's first buyers, and might even be viable long term depending on the market in general.

Innodyn is vapor.

R.D."Rick" Talbot 03-19-2006, 12:03 AM

Richard,

Thanks for the reply, I'll keep those engines in mind as I may convert my Long EZ to turbine some day, depending on cost.

airwrench 03-19-2006, 12:32 AM

I'll be happy to consider it when Innodyn delivers their first engine.

That would be sometime after the sun goes dark.

If you want to talk about a turbine engine that actually exists, we could talk about a 250 C-18. There's a guy that's just put one on a Cozy, with a custom gearbox. Very interesting. Or there's the Deltahawk, which has a good shot at delivering a batch of engines to it's first buyers, and might even be viable long term depending on the market in general.

Innodyn is vapor.
I am with you on that one, a lot of smoke from innodyne but not much else.
As far as efficiant turboshaft engines are concerned-------heck, that deep in one might as well turbofan it!! Any way you go there will be considerable $$ to make it happen, but then again one could go with the 20B and throw on a couple turbos and "walla"........a seven hundred horse bomb.:scared:

Richard Riley 03-19-2006, 12:34 AM

Deltahawk's not a turbine, it's a diesel.

If you go looking to stuff a turbine in a Long EZ eventually someone will try to sell you on a converted APU (which is what the Innodyn prototype is). Don't do it.

airwrench 03-19-2006, 12:42 AM

Deltahawk's not a turbine, it's a diesel.

If you go looking to stuff a turbine in a Long EZ eventually someone will try to sell you on a converted APU (which is what the Innodyn prototype is). Don't do it.
Yes, I know deltahawk is a diesel....turbo/supercharged I do believe. It is supposed to run on a variety of fuels as well, I have followed them for a while and.........like cont./lyco.........they are genuinely expensive:envy:

Steve_Innova 03-19-2006, 01:18 AM

Have you checked out the price of carbon fiber recently? I see quotes that it's "3 times the price of fiberglass". Ha, not even. There's a worldwide shortage of carbon fiber. Multiply by 10, at least.

Richard Riley 03-19-2006, 04:09 AM

Have you checked out the price of carbon fiber recently? I see quotes that it's "3 times the price of fiberglass". Ha, not even. There's a worldwide shortage of carbon fiber. Multiply by 10, at least.

Wow, is it that high? It's been about 4 years since I've bought any in quantity, I had no idea. I've been thinking it was in the range of $25-35/yard - sounds like I'm out of date.

Lifessamsara 04-10-2006, 08:45 AM

Hi guys and girls,
Im new around these here parts :o but I have been lurking reading a number of posts.
The idea of a 250kt cruise speed is certainly a stretch target, but just the sort of things to get people thinking and their creative juices flowing. It would seem that most of us automatically start to think of the design innovations introduced with the Berkut a decade ago (carbon this, carbon that) and I suspect that is part of the solution.......... but I do think it's going to take more than a lot of thrust (engine and prop' design), a slippery aircraft design (these canards are already slick), and reducing all the parsitic drag you can think of.
As Spodman correctly pointed out, the next big hurdle is most likely looking into the aerodynamic constraints (such as canard flutter). Like Spodman, Im not in a position to provide informed and precise aerodynamic consultancy services, but what about thinking in this direction.......... what is the fastest (non-military) canard about? One of the larger commercial derivitives perhaps? What canard designs have they incorporated, and what is the relationship with it's primary wing (how does that compare to the standard Berkut/Longes design)?
I think threads like this may be just what get's some people interested in experimental aircraft............ experimenting. Now I know some of you are thinking this is a serious business, flying, and I totally agree (yes, aviation maintenance and engineering background here). This thread is about navel gazing, thinking of the 'if only' thoughts, and giving some direction to some dreaming going on out there.
I don't think that what everyone is seeking is a very efficient cross country touring aircraft, some people do like the hotrod (why do you think they chose to build Berkuts).
The Variez and Longez inspired many people and indeed their designs/modifications, just perhaps they have some more inspiration to provide.
I look forward to your replies, flames, but most importantly your thoughts about the 250kt Open-ez ;)

Cheers,

Bruce.

karoliina
04-10-2006, 11:54 AM

One thing to consider is:

- Canards have currently quite thick wing profiles.
- thick profile = more drag
- it is thick because of the strength required and it is achievable only with a thick profile if glass is used.
- with carbon it would be possible to use thinner profile
- with increasing intentionally the lift of the fuselage, maybe the wing span could be reduced a bit too.
- the Eppler 1230 mod is a thick turbulent profile and propably quite draggy (haven't tried to simulate it or anything), a person like John Roncz would be capable of designing a new less draggy laminar profile for a replacement I am sure.

In a very draggy airplane, the wings create something like up to 60% of the drag of the airplane. Replacing the profile with a faster one, which would be better optimized for the higher cruise speed.

With the current profile, adding power does not help much. For example Cozy-Jet isn't very fast compared to how fast a jets usually are. If the drag of a profile increases exponentially above certain speed, you could be using a Saturn-V rocket engines and still be slow. I am quite convinced that making the plane faster, requires to change the wing profiles, in addition to making the fuselage etc. smooth. Small optimizations help a little, but new wings and canard could help significantly (IMHO).

Richard Riley
04-10-2006, 10:03 PM

Klaus is slowly building a new pair of wings for his Long EZ (not a typo, not talking about his Vari) with a different airfoil section and a smaller area. Also blended winglets. He says they won't be for sale.

Lifessamsara
04-10-2006, 10:59 PM

That's very interesting! Do you know if he is considering the inclusion of flapperons/flaps to accommodate TO and Landing speeds?
Do you know if he has any designs he wouldnt mind someone looking over?? :rolleyes:

dpaton
04-11-2006, 12:18 AM

I heard a nasty rumor that the cost to peek under the ultra-slick cowl of Klaus' Vari (and it's associated super low drag cooling system) was a firstborn son, indentured servitude sanding parts, and a left...er...leg, I doubt he'll let anyone short of Burt himself in on the details of his new wings.

Of course, being a nasty rumor, it might not be true.

:D

-dave

Richard Riley
04-11-2006, 02:58 AM

That's very interesting! Do you know if he is considering the inclusion of flapperons/flaps to accommodate TO and Landing speeds?
Do you know if he has any designs he wouldnt mind someone looking over?? :rolleyes:

I don't know if he's including flapperons, but I'd bet a lot of money against it.

If it were me, and I were willing to bet my life on untested wing mods (I'm not, I've got a little girl that I want to watch grow up) I'd look at Ilan Kroo's work on the C wing. I mean, if you really want a few extra knots that badly, there are worse things that you could bet your life on.

Lifessamsara
04-12-2006, 10:18 AM

I'd look at Ilan Kroo's work on the C wing. I mean, if you really want a few extra knots that badly, there are worse things that you could bet your life on.

Any idea how I could find out more about Ilan Kroo's C wing?

Bruce.

Richard Riley
04-12-2006, 11:04 AM

http://aero.stanford.edu/reports/nonplanarwings/nonplanarwings.html

Wayne Hicks
04-12-2006, 01:47 PM

"Cozy-Jet isn't very fast compared to how fast a jets usually are. "

----> Greg won't exceed the published Vne because of control surface flutter. So, he can't utilize all that power yet. He is working with the EZ jet folks and is building new elevators and ailerons. I haven't spoken to Greg in a while, but I heard rumors of new carbon wings and canard too? Anyway, he expects the new "airframe" will have a higher Vne that will allow him to put to use some of that excess power the engine is capable of generating. He's gonna go ALOT faster.

RGlos
04-13-2006, 10:06 AM

Ha

I have the standard original GU Canard. If I could push mine up to 250 Kts. I'd have to remount the canard incidence to -20 degrees just to keep the nose down. As it is I have to hold down presure on the stick at + 170 kts and that's in a dive.

The only good thing a 600 hp LEZ could do would be STO. I removed the landing "L" part of this formula as it would not shorten the landing.

Remember the faster you go, you have to have some way to get rid of lift on the canard. The same basic principles would apply to a 600 hp Piper Cub.

My 2 cents

airwrench
04-13-2006, 05:25 PM

Yes, hanging in the breeze at 250kt plus is what we are looking to approach here. The thin wings will help, maybe a swept (mildly) canard? Or, one which mechanically sweeps forward and back?:scared:

Lifessamsara
04-14-2006, 02:17 AM

Could someone explain the design concept of the swing-wing canard on the Beech Starship? Apart from being speed related, what was the primary relationship with the aerodynamic function of the canard?
A link to a suitable site that explains this would also be of benefit thanks. :)

Jon Matcho
04-14-2006, 11:13 AM

Could someone explain the design concept of the swing-wing canard on the Beech Starship? Apart from being speed related, what was the primary relationship with the aerodynamic function of the canard?I *think* it sweeps forward during take offs and

landings to achieve a lower stall speed. It sweeps back for higher speeds in flight.

A link to a suitable site that explains this would also be of benefit thanks. :)www.google.com :)

OR... visit www.uspto.gov and locate Burt Rutan's patent on this particular design. There should be drawings and a complete explanation there.

Marc Zeitlin
04-14-2006, 11:24 AM

Could someone explain the design concept of the swing-wing canard on the Beech Starship?I'll bet someone could. Apart from being speed related, what was the primary relationship with the aerodynamic function of the canard?
To meet the FAR landing speed requirements, the Starship required flaps on the main wing. Flaps substantially change the moment coefficient of the wing, and to counteract the extra nose down moment of the main wing, the canard needed to be further forward. The swinging forward of the canard was coupled to the flaps on the main wing - when the flaps were deployed, the canard swung forward, moving the center of lift of the canard forward. This kept the lift/moment balance of the aircraft correct.

It's not "speed" related - it's flaps related. Now, you only deploy flaps at relatively low speed, but no matter what the speed, if the flaps weren't deployed, the canard doesn't move.

The mechanism is extremely complex.

The patent # is 4,641,800.

Interestingly enough, while poking through the patents, a derivative patent for a SLIDING canard is presented by a "John A. Lockheed", in 1989, that uses a COZY III as the basis for the figures. The figures are reasonably explicit as to the workings. Whether this aircraft was ever built, I have no clue - I've never heard of it or seen it. The patent # is 4,848,700.

Lifessamsara
04-15-2006, 01:33 AM

Well Marc, thanks for that, it certainly made interesting reading (along with some of the other concepts in the Patents in the same area).
It would seem if a canard used a swing canard configuration along with a flap it would provide a suitable TO/landing performance, and provide a lesser drag profile for for higher speed cruise (less drag as Carolina pointed out).
I wonder, does this seem to be indicating the 250kt OpenEz design brief?
What kind of flap design could be used on an OpenEz plan?
Im enjoying the open thinking in this thread so far, and hope it continues.

Cheers,

Bruce.

Marc Zeitlin
04-15-2006, 03:37 PM

It would seem if a canard used a swing canard configuration along with a flap it would provide a suitable TO/landing performance,Since canards already have "suitable" TO/Landing performance, the addition in weight and complexity of moving the whole canard airfoil is completely unwarranted. It's on thing to take on the complexity in a 6-8 seat bizjet - it's quite another in a 4 seat (or 2 seat) GA aircraft. It's why you don't see multi-surface fowler flaps on GA aircraft, either.

and provide a lesser drag profile for for higher speed cruise (less drag as Carolina pointed out).If there were any truth to Karolina's statements about drag, then it might be worth thinking about. However, her suppositions about drag and airfoil shapes, with respect to L.E.'s and COZY's are incorrect. Witness the many canard aircraft (Berkut, supercharged E-Racer, souped up V.E.) that can fly well into the high 200 - 275 Kt. range with the stock airfoils. It's not the thickness of the airfoils that's creating any issues here.

I wonder, does this seem to be indicating the 250kt OpenEz design brief?
What kind of flap design could be used on an OpenEz plan?I'm not sure what your first sentence means. Personally, I wouldn't even think of adding flaps, and the concomitant complexity of canard rotation/sliding to my aircraft - the reduction in reliability alone would make it a non-starter. I can land and stop in less than 2000 ft, normally - 3000 when at gross weight and forward CG. There are almost no airports that I want to go to that I can't get in and out of.

If I wanted to go faster, I'd concentrate on intersection drag of the gear, cooling drag, and I'd turbocharge my engine. Leave the airfoils out of it.

Jon Matcho
04-18-2006, 11:24 AM

If there were any truth to Karolina's statements about drag, then it might be worth thinking about. However, her suppositions about drag and airfoil shapes, with respect to L.E.'s and COZY's are incorrect.Karollina has a valid point: airfoils CAN be replaced to achieve less drag. Klaus Savier apparently believes this to be the case (I'm sure he's not doing it for 'looks').

Witness the many canard aircraft (Berkut, supercharged E-Racer, souped up V.E.) that can fly well into the high 200 - 275 Kt. range with the stock airfoils. It's not the thickness of the airfoils that's creating any issues here.I'm not familiar with the "souped up V.E.", but the others performers you mention (those that can get 250kts?) are powered with Lycoming 540s. Your point is valid of course -- a carbon-skinned Berkut will indeed go fast.

If I wanted to go faster, I'd concentrate on intersection drag of the gear, cooling drag, and I'd turbocharge my engine. Leave the airfoils out of it.What else? How about the intersection of the strakes to the fuselage (upper and lower)? Can that be improved? What about the winglet-wing intersection the Cozy Girrrls did (check out 'Current Status' on their Web page (http://www.cozygirrrl.com/menupage.htm))?

Marc Zeitlin

04-18-2006, 01:09 PM

Karollina has a valid point: airfoils CAN be replaced to achieve less drag. Klaus Savier apparently believes this to be the case (I'm sure he's not doing it for 'looks').Klaus is trying to get the last few knots out of an airplane that has already had everything even remotely easy done to it (assuming he's doing to the L.E. what he's already done to his V.E.). Karollina's point about canard thickness being a substantial portion of the drag of the aircraft is just wrong. Go look at drag polars of various airfoils appropriate for canards, find the minimum Cd, and then think about how many pounds of drag dropping that Cd will eliminate. Then consider that a reason to change the airfoil of the canard would be to eliminate the propensity for Mach Tuck at the high speeds that Klaus is trying to achieve.

There may very well be airfoils out there that would have better Cd's at the Cl's used for the canard, but the thickness is not the major issue. That's what I was directing my comments to, along with the comment that fuselage lift could replace wing lift. Since wings are far more efficient (Cl/Cd) lifting surfaces than fuselages, that's the last thing you'd want to do. Plus, thin airfoils have terrible stall characteristics - not optimal for a canard aircraft.

Take a look at:

http://www.mh-aerotools.de/company/paper_3/yaka.html

You can see that the minimum Cd for all the airfoils listed (with smooth surfaces) is about 0.005, in the range of Cl's we're talking about. You're not going to substantially reduce that (at low Cl's) by changing airfoils. A look at Appendix IV of "Theory of Wing Sections" shows that almost all minimum Cd's are in the range of 0.004 to 0.006, with the lower "drag buckets" coming only in a very small range of Cl's (with thin sections). You might change OTHER characteristics by going to a thinner airfoil, but not the minimum drag coefficient, at least not substantially. This implies that changing canard airfoils will not have a large effect on top speed (from a drag standpoint).

I'm not familiar with the "souped up V.E.", but the others performers you mention (those that can get 250kts?) are powered with Lycoming 540s. Your point is valid of course -- a carbon-skinned Berkut will indeed go fast.I was referring to Klaus's aircraft. His O-200 puts out substantially more than 100 HP.

What else? How about the intersection of the strakes to the fuselage (upper and lower)? Can that be improved? What about the winglet-wing intersection the Cozy Girrrls did (check out 'Current Status' on their Web page (http://www.cozygirrrl.com/menupage.htm))?Everything can be improved. The things I listed are the main ones, and will get you many knots relatively simply. The things you list are second order effects - optimizing them MIGHT get you a few knots, but it's hard to say.

Jon Matcho

04-18-2006, 05:39 PM

Then consider that a reason to change the airfoil of the canard would be to eliminate the propensity for Mach Tuck at the high speeds that Klaus is trying to achieve.That's a joke right? I hope so... because I think I just got it!

That's what I was directing my comments to, along with the comment that fuselage lift could replace wing lift. Since wings are far more efficient (Cl/Cd) lifting surfaces than fuselages, that's the last thing you'd want to do.I agree, for other reasons, namely the complexity as indicated by the reference material you're citing.

Still, what about a more spherical nose shape that's better blended into the body from the canard forward? Everyone wants to put on supersonic nose cones, but the perfect subsonic shape is a rain drop (cone w/sphere at end). I've been thinking about designing this new use using CAD, and taking cross sections for the bulkheads needed to form the "improved" shape. What do you think, worthwhile? 10 knots or 0.1kts?

Marc Zeitlin

04-18-2006, 06:49 PM

That's a joke right? I hope so... because I think I just got it!Well, you'll have to explain it to me, because I'm not sure what you "got" - there was no joke....

Still, what about a more spherical nose shape that's better blended into the body from the canard forward?.... What do you think, worthwhile? 10 knots or 0.1kts?A lot closer to the latter than the former. It's not like folks with the long nose L.E.'s are seeing any speed decreases.....

Jon Matcho
04-18-2006, 09:33 PM

Well, you'll have to explain it to me, because I'm not sure what you "got" - there was no joke....I thought 'mach tuck' was a phenomena that occurred as an aircraft approached the speed of sound (~mach 0.85?). If that's the case, I don't understand how 'mach tuck' is anything anyone in a canard will have to worry about. Then again, I suppose the jets and rockets could get that fast if they tried.

What am I missing? What's 'mach tuck' have to do with Klaus?

Marc Zeitlin
04-18-2006, 10:38 PM

I thought 'mach tuck' was a phenomena that occurred as an aircraft approached the speed of sound (~mach 0.85?). If that's the case, I don't understand how 'mach tuck' is anything anyone in a canard will have to worry about. Then again, I suppose the jets and rockets could get that fast if they tried.

What am I missing? What's 'mach tuck' have to do with Klaus?You must have missed the multitudinous discussions of Mach Tuck on both the mailing list(s) and the fora. The Roncz canard is theorized to have a critical Mach # of about 0.55 - 0.75. At high altitudes, with a turbocharged engine, canards can approach that. That was my reference - to go a LOT faster in one of our aircraft, the canard airfoil would have to be changed in order to avoid this phenomena.

Read the thread:

http://canardaviationforum.dmt.net/showthread.php?t=2085

Especially Richard Riley's last sentence in his last post.

Jon Matcho
04-18-2006, 11:36 PM

You must have missed the multitudinous discussions of Mach Tuck on both the mailing list(s) and the fora.I do recall the discussions, and a visit to the link you provided reminded me of what I thought then -- that the issue is likely (and hopefully) going to have nothing to do with my airplane.

Thanks for the education Marc.

7480W
04-19-2006, 03:19 AM

Has anyone considered the possiablity of sweeping the main wings more to reduce drag. I know that with this the twist would have to be increased in order to not stall tips first. Maybe im being crazy here. One possibality with too much money and time the possibality of movable wings, so it could remain the same landing and low speed flight. If the wings were swept back far enough it could almost be a delta style wing. I know some very different principials, but it could help with the mach number problem, I was told that a greater swept wing with the same airfoil has a higher mach # usage, Though not from the most relaible sorce.I think that the cannard would have to be different as well to stop it from being the limiting factor. I think this will get really complex really quickly but, Just a thought. Thank You all for being so helpful as well all the great advice in this thread.

AP3_C
04-19-2006, 04:47 AM

"Mach Tuck"

From the little info I have I understand that the occurance of Mach Tuck is given to the situation where the Centre of Pressure transfers from the (approx) forward third of the wing section in normal flight to the rear third (approx) of the wing section as the aerofoil approches and passes through the speed of sound thus causing the aircraft to pitch down.

Others out there may have a better explination but I cannot see how aircraft like the LE and a like would suffer from a situation like this as the speeds required to fly at would be well exilerating to say the least. :D

Jamie

AP3_C
04-19-2006, 04:58 AM

Did a bit more reading and I can see how maybe the LE type aircraft can have critical Mach number issues.

Critical Mach number - speed at which the aircraft is flying to have air flow on airfoil accelerated to the speed of sound. Thus possible Mach Tuck issues.

Jamie

Lifessamsara
04-19-2006, 05:46 AM

Well guys, I am gladly receiving quite an education through this thread, so thankyou.
Marc, I can see that the current airfoil for the main wing may be suitable for a cruise speed of 250kts (as that was the original concept of this thread), and that you are indicating addressing the the design of the fuselarge to reduce drag may be the best way to produce an economical high speed cruise.
Id be interested to know what your thoughts are about improved performance of the nose, canopy and width/height of the fuselarge are Marc. I for one do not need to widen a cockpit 2-4" just yet (that middle age spread has not kicked in just yet ;))
Im also interested in the discussion on the vortex generation drag performance associated with our winglet wings. Is there a way to also reduce drag here?
Let's not forget what Mike Arnold achieved with with just 65hp.... 213mph. Some guys have been dropping 220hp in the back of their canards....... why cant a 300kt top speed and 250kt possible with a basically slippery design and all that power be achieved?
Keep up the open and creative thinking guys, and the technical discussion of the realitive merits of each idea (and leverage off that thinking).
I look forward to the future posts.

Cheers,

Bruce.

karoliina

04-19-2006, 06:27 AM

shapes, with respect to L.E.'s and COZY's are incorrect. Witness the many canard aircraft (Berkut, supercharged E-Racer, souped up V.E.) that can fly well into the high 200 - 275 Kt. range with the stock airfoils. It's not the thickness of the airfoils that's creating any issues here.

I made that assumption based on the fact that Greg Richter does not go faster than 200-240 kt with his Cozy-Jet according to the article. That is not very much considering that there is a lot of more power available in the jet engine than there is in a piston engine (no matter what horse power) at the same altitude. I may be also incorrect with the assumption, but to me it sounded like the drag starts to rise exponentially above the normal speed range of the canards because the airfoils are not designed for a such speed range. As a matter of fact on the other hand, I am not aware to which speed range the airfoils of Cozy are designed to and would appreciate if somebody with more knowledge would enlighten me.

Best Wishes,
Karoliina

Marc Zeitlin

04-19-2006, 11:54 AM

I made that assumption based on the fact that Greg Richter does not go faster than 200-240 kt with his Cozy-Jet according to the article."Does Not" and "Can Not" are two different things. Greg has explicitly said that his aircraft COULD go a LOT faster, but he limits the speed because the Vne of the COZY is 220 mph IAS, so he doesn't go faster than that.

... I may be also incorrect with the assumption, but to me it sounded like the drag starts to rise exponentially above the normal speed range of the canards because the airfoils are not designed for a such speed range. And yet Jack Morrison's E-Racer has gone ~300 mph, as have some Berkuts, and Klaus's V.E. is in the 250 mph range. Drag does rise, and the aircraft are not designed for those speeds, but they can achieve them with a lot of power and judicious drag reduction. Greg's jet could EASILY beat those #'s, if he was willing to exceed Vne.

As a matter of fact on the other hand, I am not aware to which speed range the airfoils of Cozy are designed to and would appreciate if somebody with more knowledge would enlighten me. As Richard Riley has pointed out, the Critical Mach # of the canard is somewhere between .55 and .75, and the main wing may not be far different. This gives an upper limit for TAS. Without the drag polars, we can estimate a Cd of 0.005 for each wing at low AOA's and get an approximate speed/power curve. It's pretty obvious (since it's been done) that 300 mph is achievable with enough power, and "enough" is defines as somewhere in the 300 HP range.

Let's not forget what Mike Arnold achieved with with just 65hp.... 213mph. Let's not forget that that's a tiny 1 seater. A very efficient one, no doubt, but tiny.

Some guys have been dropping 220hp in the back of their canards....... why cant a 300kt top speed and 250kt possible with a basically slippery design and all that power be achieved?It IS possible, and it's been done. I've said so many times, and others have proved it. The question is not CAN it be done, but how close to the edge are we when doing it?

Len Evansic

04-19-2006, 02:48 PM

I can't speak for Greg, but he has indicated to me that the CozyJet is a bit of an R&D mule. He's still tinkering with it, and still expanding the envelope. The CozyJet is itself not an end, but a beginning of his next project where he wants to tackle the Vne issues with stiffer wing structure and some other changes. As much as he is experimenting with the design, he is trying to do so in a cautious manner.

-- Len

Jack Morrison 04-19-2006, 11:12 PM

Mark is exactly correct on this issue. I have been there and let me tell you 300 mph is extremely fast for these canard AC. No one really knows where that edge is, and I would be verly reluctant to push past what has already been accomplished . If mach tuck occured at these speeds, there is no recovery and your last ride would wind up being a slow ride in a hearse. I am not a young person in age, but I plan to be around for quite a while

Jack Morrison

longez360 04-20-2006, 07:12 AM

That is one heck of a nice E-Racer you have Jack. I managed to battle though a crowd and see it at OSH. What sort of performance (TAS) are you seeing at altitude?

Cheers,

Wayne Blackler
IO-360 Long EZ VH-WEZ
Melbourne, AUSTRALIA

Jack Morrison 04-21-2006, 12:51 AM

Wayne
Last year I saw 253kt T . at 10,000 2980 rpm- 43in MP . That was turning a catto 3 blade 66/103. Im sure there was more left but I have been fighting cht gremlins for 5 years on this AC and I could not hold any HP down for over a minute or two. Estimated 360 hp is not easy to cool. I have changed my cooling system 6 times in the last 5 years and have tried about every alteration possible to improve each system with only limited success. That is until today about 41/2 hours ago. With the new(7) designed plenums I got the near perfect differental numbers I was looking for and the cooling was great. I still have not tested my new prop, a catto 64/113. I will post the results in the next few months. I am going to disassemble the Ac this weekend and strip all the paint off and do a repaint, (same colours)I should loose about 100+ lbs. Lousy job but I will enter the cup race this year and need to loose some weight. If all works out as planned, I should do well in the race, only problem I have to run in unlimited. By the way, that longEZ of your 's is georgous. You have done a great job on your EZ. Good luck down under.

Jack

Jon Matcho 04-21-2006, 09:37 PM

Jack... it's great to hear you've got your cooling working. That had to be driving you nearly insane.

I'll be looking forward to seeing some pics, or looking things over in the future.

Jack Morrison 04-21-2006, 11:29 PM

Thanks Jon
I guess persistance and dedication do rule. One of these days soon, when I finally get back together, I'll take you for a ride, its impressive. I'll send some photos of the new cowlings when the painting is completed. They netted me + 8 kts.

Jack

Lifessamsara 04-22-2006, 12:28 AM

Hi Jack,
Im sure we are all very interested to benefit from your knowledge and ideas of what aspects of canard design contribute to real gains in aerodynamic efficiency.
Do you have a website for your aircraft and your endeavours?
You mentioned that you gained 8kts from your mod's to your cowlings, what other mod's have revealed benefits?
Thanks for sharing your experience.

Bruce.

longez360 04-24-2006, 03:25 AM

Jack,

Congratulations on the cooling success. 5 years of experimentation must have been damned frustrating. Appreciate the reply. Will get back to you for some pictures once you have it all repainted.

Cheers,

Wayne

Jack Morrison
04-28-2006, 10:49 PM

Thanks Wayne/Bruce from dowm under.

Tomorrow I will disassemble the AC, strip off the old paint and redo. It will be interesting to see how much weight I save. I will keep every one posted with the before and after weights. I am looking for 100 to 130 lbs reduction. If that is correct, I will be able to loose another 30 lbs in the nose ballast, because most of the weight is aft CG weight. That could possibly net me 150-160 lbs weight. I only weigh 165. Should take about 3-4 weeks.

Jack

Jon Matcho
04-29-2006, 07:27 PM

Jack, why not consider a new and improved paint scheme while you're at it? Not that there was ANYTHING wrong with the current scheme.

Also, what's the technique for stripping paint off of a composite aircraft?

Jack Morrison
04-29-2006, 09:49 PM

Lon
I have experimented with at least 10-15- different designs and colors and I keep returning to the original scheme. There will be a new take-off on the flames but otherwise it will be the same. What can I say. About the striping of the paint, I talked with two people who do soda blasting and I am not comfortable with the process. I had one of the companies trial test my old lower cowling and it was terrible. So, today I removed the left wing and sanded it and the left strake to the primer, block sanded it and will reprime it tomorrow and block it a second time. I suspect it will take me at least 3 weeks to finish the repaint. The sanding is going faster than I would have expected but it sure is messy. I weighed the wing before striping and will weigh it when completely stripped. I started with 36 grit-to 80 grit-to 150 grit and reprimed. then 320 for final sand and then seal. Always block sand all coats. I'll let you know haw much weight I saved.

Jack

athomp58
04-30-2006, 12:19 AM

Jack,
What brand paint do you plan to use? Is it an acrylic urethane? Do you think clear coating it would reduce drag?

Aubrey

Richard Riley
04-30-2006, 01:51 AM

Lon
I have experimented with at least 10-15- different designs and colors and I keep returning to the original scheme. There will be a new take-off on the flames but otherwise it will be the same.

Are there any pictures of it on the web?

Jack Morrison
04-30-2006, 07:47 PM

Richard
Not yet but it will be different. I'll send some photos wnen I have completed the painting. I am trying to use the BASF extreme rainbow colors in the flames. For all interested, I am using PPG base/clear coat paint and have painted several AC with this product and am very satisified with the results. It is no way the least expensive product but I have been using PPG products for over 45 years and have found them to be excellent in quality, performance and application.

Jack

Jack Morrison
05-13-2006, 01:08 AM

OK
I removed both wings and weighed the left wing, with all control surfaces attached, wireing for lighting and nav/strobe lights and weighed 93 lbs. I originally put on 5 coats of acyrlic laq. paint, did not like the results, sanded down, recoated with sealer, base coat stripes, and 3 high build PPG 2042 clear coat, sanded and buffed. Over the next 8 years painted the AC 3 more times the same way. I sanded the paint off to the substrate, bubbles, and reweighed the wing. I could hardly believe the results. Total difference was 10 lbs. I went to the paint store and weighed the product less the cans at 96.5 lbs to paint the total AC one time. I estimate that one wing is about 1/4 the paint applied, so that would be about 24 lbs applied and actual weight on the AC would be about 3 lbs per paint job. At this point, I would estimate that the total weight for painting this type AC, And I am talking primer, sealer, base coat, stripes, and 3 clear coat does not weigh more than 15 lbs at the most. I have painted all my life and had no idea on how much waste there was in the application of paint, there was no reason until know. I will not know the final weight savings until reassemble and do a final weight and balance. I painted a Lancair about 5 years ago and after talking to him last week, he said that he did a weight and balance before paint and without upholstery, and weighed in after painting and upholstery at 41 lbs more. Ruined my day. So I wouldn't be worried about putting a nice paint job on your AC, the weight penalty will not hurt you. One good note, 50% of the weight is in the wings which are way behind CG and I was able to remove 25 lbs of ballist from my nose. I'll post again when I have completed the project, hopefully by the end oa the month.

Jack

airwrench 05-14-2006, 05:13 PM

anytime you get to toss ballast overboard you gain at every level, and it is always nice to be able to carry a little extra fuel on those long----ain't got time to stop trips!

Jack Morrison 05-20-2006, 08:46 PM

I agree 100%. With 360 HP, it does not help a great deal. I have installed an adjustable wastegate on my intake side to try to improve MPG. I'll let everyone know how effective it is after all my testing is complete. This stripping project is a pain in the butt.

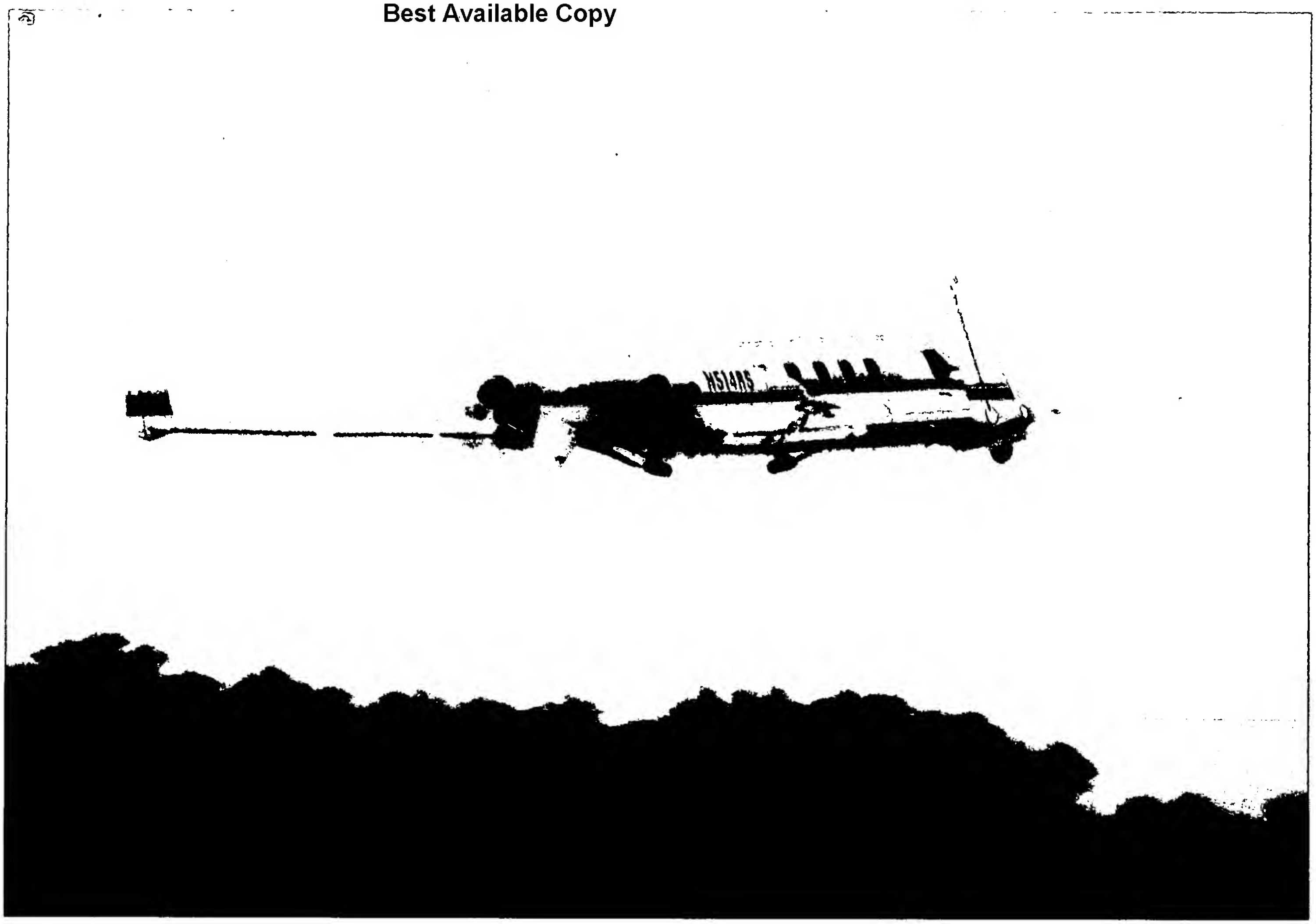
Jack

airwrench 05-20-2006, 10:59 PM

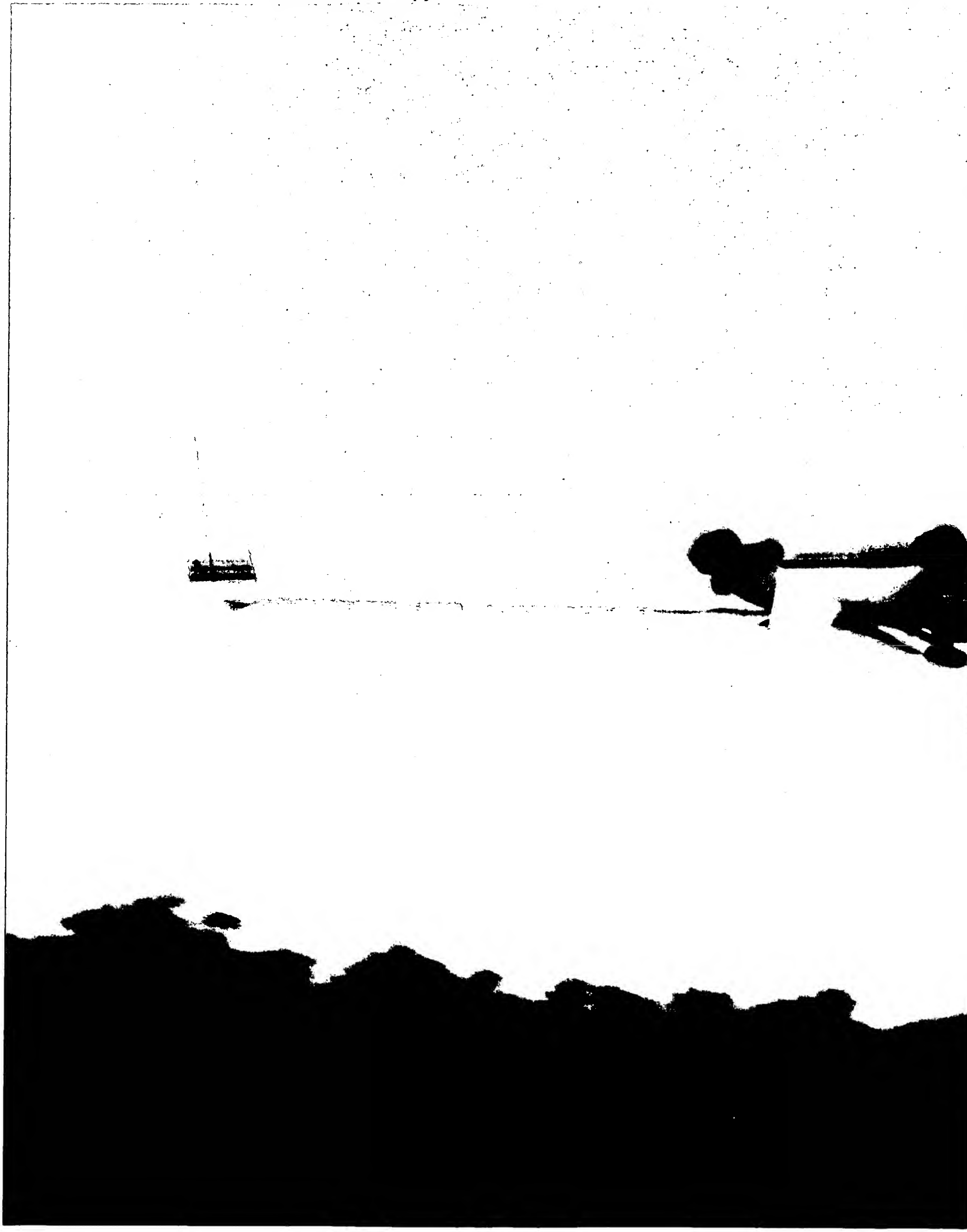
I agree 100%. With 360 HP, it does not help a great deal. I have installed an adjustable wastegate on my intake side to try to improve MPG. I'll let everyone know how effective it is after all my testing is complete. This stripping project is a pain in the butt.

Jack
MPG numbers are nice when you are not trying to go around the pack. You know, those times when you fall out of altitude and drop in for a little sight seeing, 15+ gph just gets into the pocketbook a little more than comfort allows. I am building a 13B, using a T-4 turbo and the stock injection system. I will probably bump high horsepower for a moment, til the temps tell me to back out of it!!!!!!!!! I thought for a long time about putting a IO540 in my ez but, getting good fuel numbers is hard. My goal is to have good long range and acceptable cruise performance.....hope to hang around 200 kts while still staying in the ballpark on the fuel usage. If I had 360hp in the back, lookout!!!!!!!!!!!!! Enjoy the paintwork:)

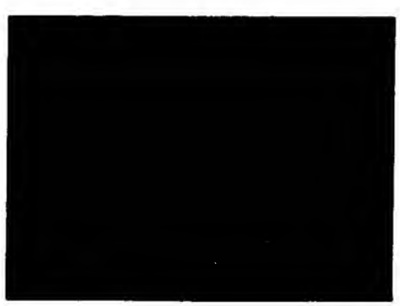
Attachment 'T



Enlarged pictures from
attachment 3B




N514RS



FAA Registry
N-Number Inquiry Results

N514RS is Assigned

Aircraft Description

Serial Number	NC-51	**Type Registration**	Individual
Manufacturer Name	BEECH	**Certificate Issue Date**	07/03/2007
Model	2000	**Status**	Valid
Type Aircraft	Fixed Wing Multi-Engine	**Type Engine**	Turbo-Prop
Pending Number Change	None	**Dealer**	No
Date Change Authorized	None	**Mode S Code**	51470723
MFR Year	1994	**Fractional Owner**	NO

Registered Owner

Name	SCHERER ROBERT P TRUSTEE				
Street	861 PRODUCTION PL STE A				
City	NEWPORT BEACH	**State**	CALIFORNIA	**Zip Code**	92663-2861
County	ORANGE				
Country	UNITED STATES				

Airworthiness

Engine Manufacturer	P&W	**Classification**	Standard
Engine Model	PT6A SER	**Category**	Commuter
		A/W Date	09/13/1994

This is the most current Airworthiness Certificate data, however, it may not reflect the current aircraft configuration. For that information, see the aircraft record. A copy can be obtained at Http://162.58.35.241/e.gov/ND/airrecordsND.asp

Other Owner Names

None

United States Patent [19]

Rutan

[11] **Patent Number: Des. 292,393**

[45] **Date of Patent: ** Oct. 20, 1987**

[54] **AIRPLANE**

[76] Inventor: **Elbert L. Rutan, Hangar 73 Mojave Airport,, Mojave, Calif. 93501**

[**] Term: **14 Years**

[21] Appl. No.: **524,439**

[22] Filed: **Aug. 18, 1983**

[52] **U.S. Cl.** **D12/332;** D12/341; D12/344

[58] **Field of Search** .... D12/319-344; 244/45 R, 45 A, 55, 13, 91, 199

[56] **References Cited**

U.S. PATENT DOCUMENTS

D. 256,905 9/1980 McComas et al. .... 244/45 A

4,240,597 12/1980 Ellis et al. 244/199

OTHER PUBLICATIONS

Flight Int'l (May 1982), p. 1318 Rockwell's Forward-Sweep Demonstrator.

Automotive Engr. (1980 Dec.) p. 49, vol. 88 No. 12.

Primary Examiner—James M. Gandy

Attorney, Agent, or Firm—Edwin L. Spangler, Jr.

[57] **CLAIM**

The ornamental design for an airplane, as shown.

DESCRIPTION

FIG. 1 is a perspective view looking down and forwardly upon the upper right rear of an airplane showing my new design;

FIG. 2 is a perspective view looking down and to the rear upon the upper right front thereof;

FIG. 3 is a top plan view thereof;

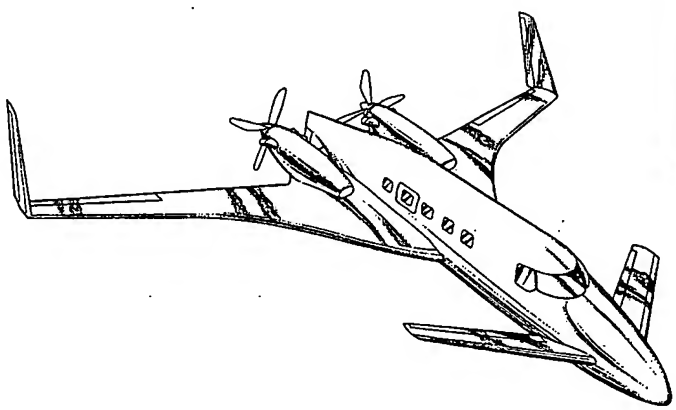
FIG. 4 is a front elevation view thereof;

FIG. 5 is a bottom plan view thereof;

FIG. 6 is a rear elevation view thereof;

FIG. 7 is a left side elevation view thereof; and,

FIG. 8 is a right side elevation view thereof.



[redacted]

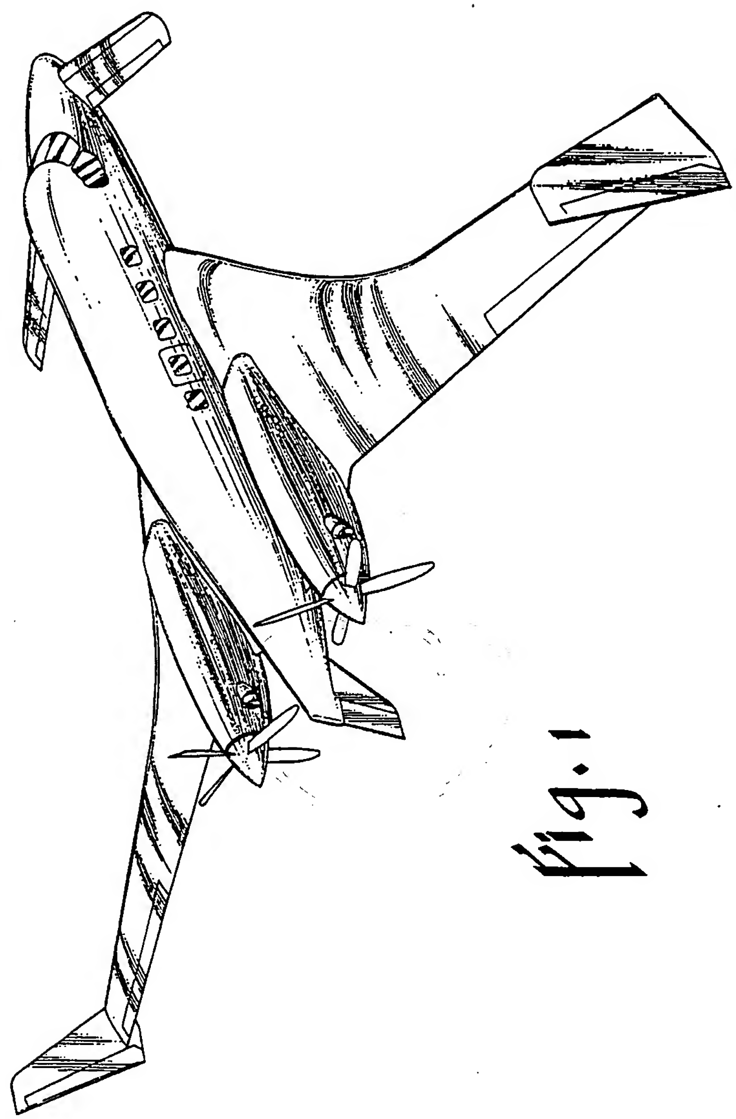


Fig. 1

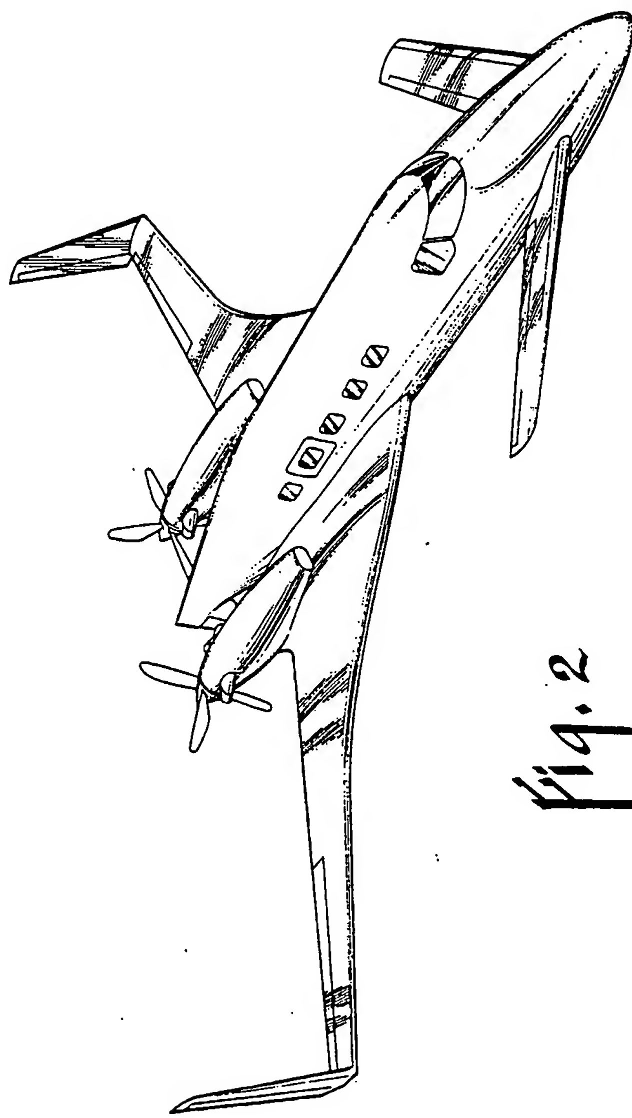


Fig. 2

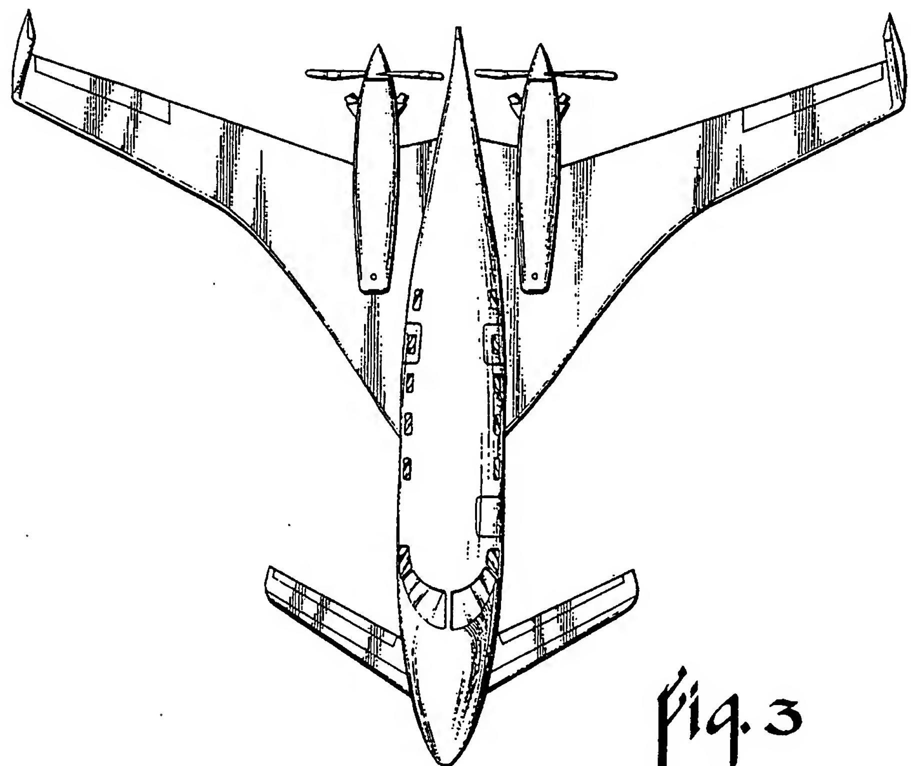


Fig. 3

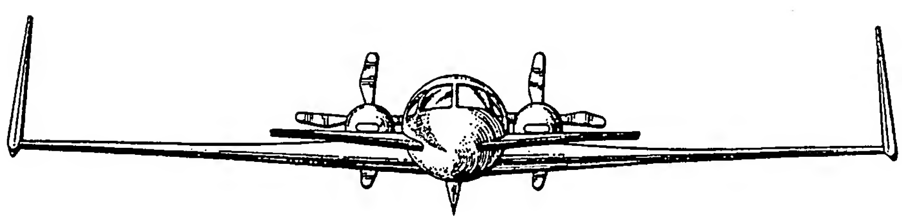


Fig. 4

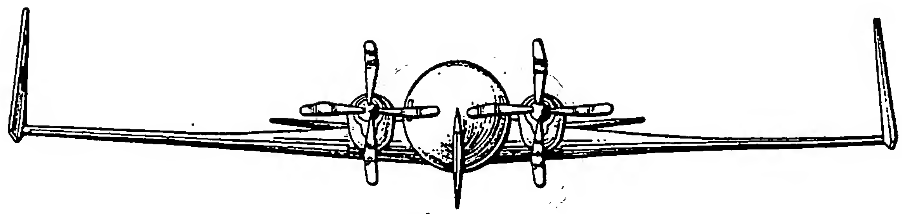


Fig. 6

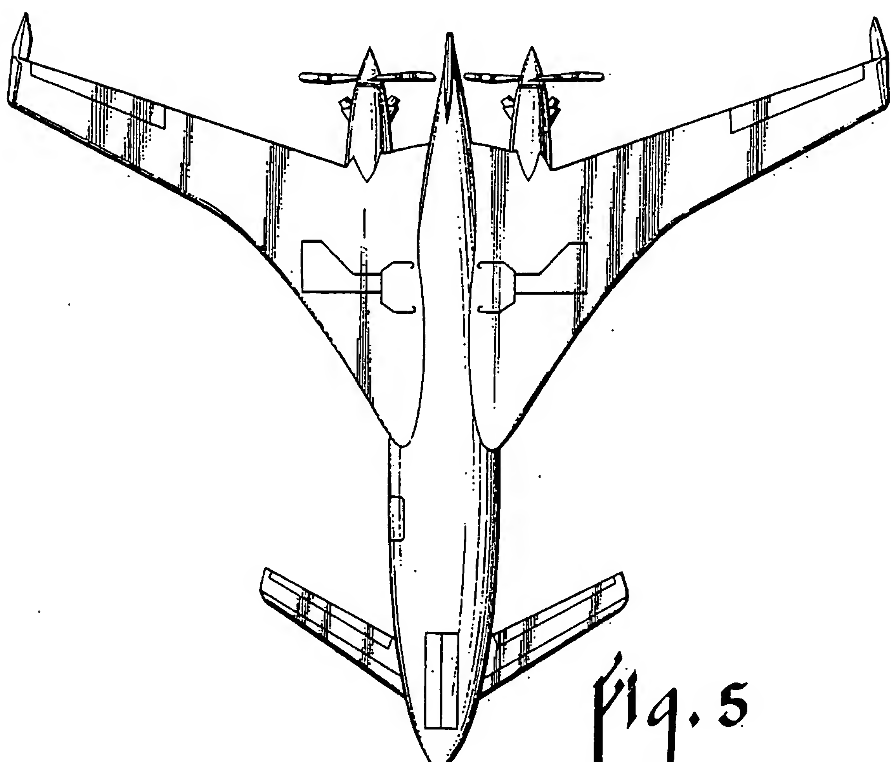


Fig. 5

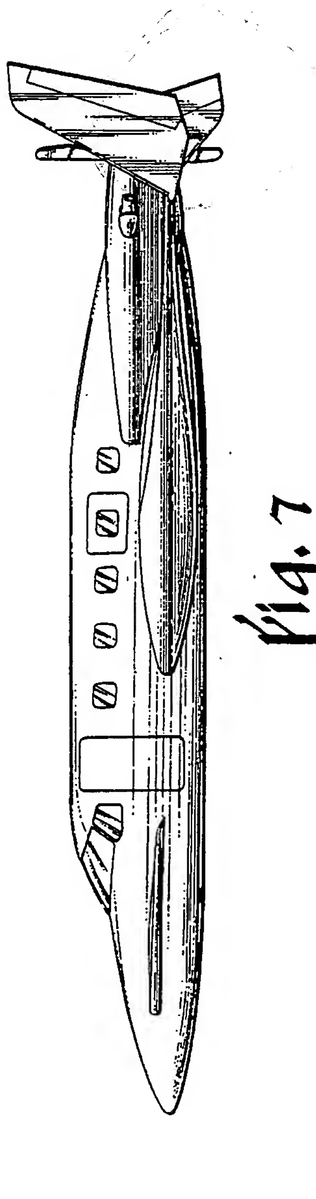


Fig. 7

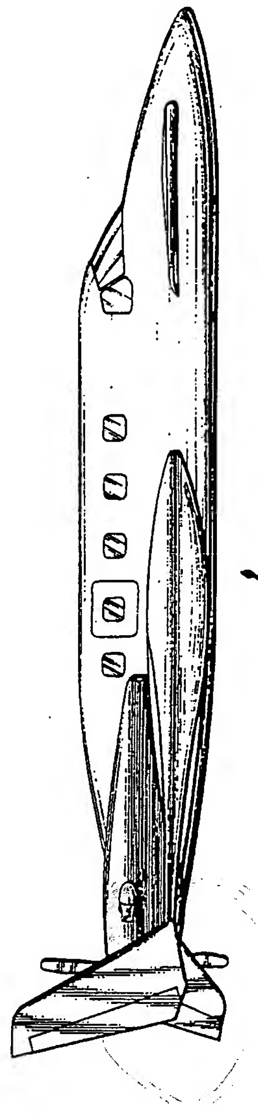


Fig. 8

Attachment 5

Main

Introduction Project Info Main Evidence?

Back
SpaceShipOne
Proteus
Freewing UAV
ATTT
Ares
M309

ATTT

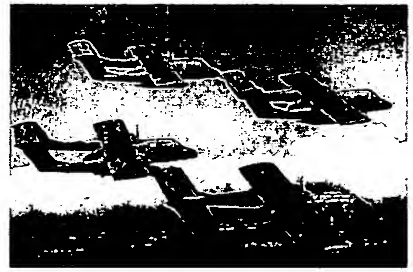
ATTT stands for Advanced Technology Tactical Transport.

ATTT

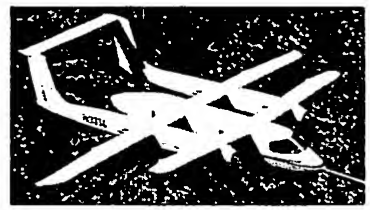
A (

The ATTT was developed and test flown by Scaled Composites, Inc. under contract to DARPA. The initial flight test program consisted of 51 flights with the original cruciform tail configuration, measuring and refining performance, stability and control, and handling qualities.

In an effort to improve the aft loading capability of the aircraft and to correct aerodynamic deficiencies discovered during the test program, the ATTT aircraft was modified with a twin-boom tail whose general configuration was similar to that of the Rockwell OV-10 Bronco. Bellow is a picture of a few Rockwell OV-10 Broncos flying in formation:



Pratt and Whitney of Canada PT6A-135A turboprop engines were attached to the twin booms in a tractor configuration. A simple fully mechanical flight control system was installed, with full control available from both seats. The Scaled-designed landing gear is actuated using electric motors.

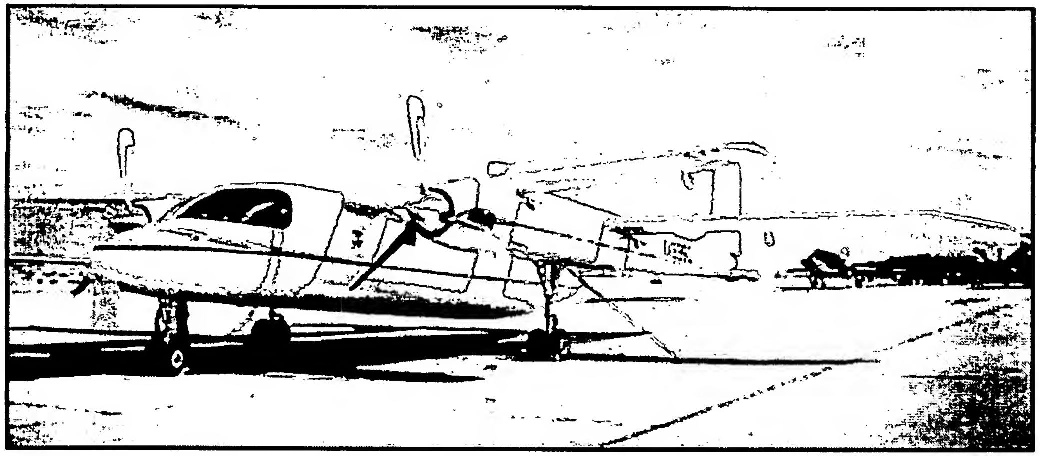


The high lift configuration consists of eight Fowler-type flaps, each of 43% chord. The flap system was designed to allow the initial takeoff roll to be performed with the flaps extended, but at low deflections to minimize takeoff drag. As rotation speed was neared, the flaps were quickly rotated to the maximum lift position via a separate pilot action. The ATTT was a key program for Scaled. It demonstrated their ability to perform a challenging aerodynamic and structural design, and to build, test, and deliver what amounted to two different manned research airplanes, including all design and flight test data, to DARPA for less than 3 million dollars, including all recurring and nonrecurring costs.

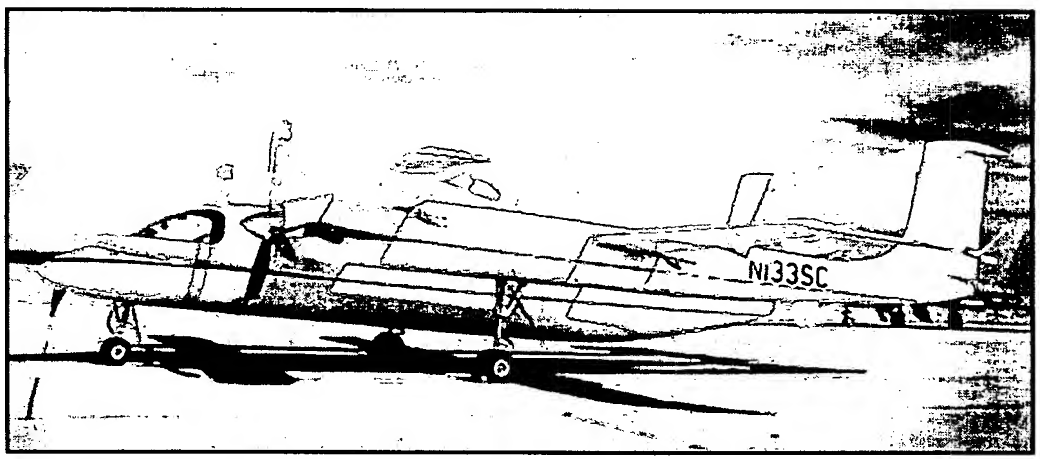
The ATTT is currently in storage at the Air Force Flight Test Center Museum, at Edwards Air Force Base.

Model 33 Advanced Technology Tactical Transport (ATTT) demonstrator

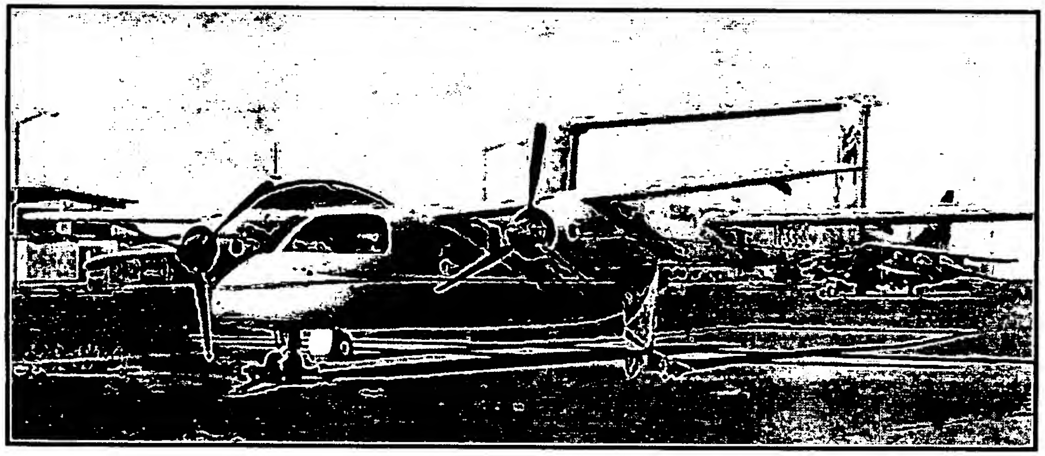
The Model 133-4.62 Advanced Technology Tactical Transport (ATTT) proof-of-concept demonstrator is a 62% scaled version of an airplane designed to challenging STOL and long range requirements. The ATTT was developed and test flown by Scaled Composites, Inc. under contract to DARPA.



Scaled Composites Model 33 Advanced Technology Tactical Transport (ATTT) demonstrator, N133SC on the Mojave Airport flightline on October 30, 1989. It was built in 1988 as a 68%-scale proof of concept vehicle.



Scaled Composites Model 33 Advanced Technology Tactical Transport (ATTT) demonstrator, N133SC on the Mojave Airport flightline on October 30, 1989.



Scaled Composites Model 33 Advanced Technology Tactical Transport (ATTT) demonstrator, N133SC on the Edwards Air Force Base south base flightline on October 25, 2003.

Attachment 6

We are presently building a list of all known canard type aircraft so that we may create dedicated reference pages for each. Based on demand, we can setup designated areas within the forums.

Plane	Manufacturer	Designer	Type	Build	Fan Sites
1903 Wright Flyer	Wright Brothers	Orville & Wilbur	Ultralight	Plans	www
Aeriks 200	Aceair		Experimental	Kit	
Aerocanard	Aerocad	Jeff Russell (based on Cozy Mark IV)	Experimental	Kit	www
AFTI/F-16 (vertical canard)					www
ARES	Scaled Composites, LLC	Burt Rutan			
ATTT	Scaled Composites, LLC	Burt Rutan			
Avanti P180	Piaggio Aero Industries S.p.A.		GA	Complete	
B-1A/B Lancer/Bomber			Military		
Berkut	Berkut Engineering	Dave Ronnenberg (based on Long EZ)	Experimental	Kit	www
Catbird	Rutan Aircraft Factory, Inc.	Burt Rutan			
Cosy Classic	Co-Z Development Corporation	Nat Puffer (based on Long EZ)	Experimental	Plans	www 1 www 2
Cozy Mark III	Co-Z Development Corporation	Nat Puffer	Experimental	Plans	www 1 www 2
Cozy Mark IV	Aircraft Spruce and Specialty Company (from Co-Z Development Corporation)	Nat Puffer	Experimental	Plans	www 1 www 2
Defiant	Rutan Aircraft Factory, Inc.	Burt Rutan	Experimental	Plans	
Dragonfly	SlipStream Industries Inc.	Bob Walters (based on Quickie)	Experimental	Kit	
Eagle 150B	Eagle Aircraft Pty. Ltd.	John Roncz	GA	Complete	
E-Racer	Shirl Dickey Enterprises	Shirl Dickey (based on Long EZ)	Experimental	Plans	www
F 19a		Heinrich Focke			www
F-21A Kfir	Israel Aircraft Industries		Military		www
Falcon (UL, XP)	American Aerolight	Romuald Drlik	Ultralight, Experimental	Kit	www
Falcon 2000	Air Command International, Inc.	Romuald Drlik	Experimental	Kit	www
Firefly	Velocity, Inc. (made by Shinyoung Heavy Industries Co., Ltd.)	(based on Velocity XL)	Experimental	Kit	
Fw 42	Focke-Wulf Flugzeugbau AG	Heinrich Focke	Military		www
GB-888A	Burnelli Company	Vincent Justus Burnelli			www
Ibis	Junqua-Diffusion	Roger Junqua	Experimental	Plans	
J7W1 "Shinden"	Kyushu Hikoki K. K.	Masaoki Tsuruno	Military		www 1 www 2
JAS 39 Gripen	BAE Systems and Saab		Military		
Jian-10 (J-10 / F10)	China		Military		www
	Lockheed Martin Aeronautics				

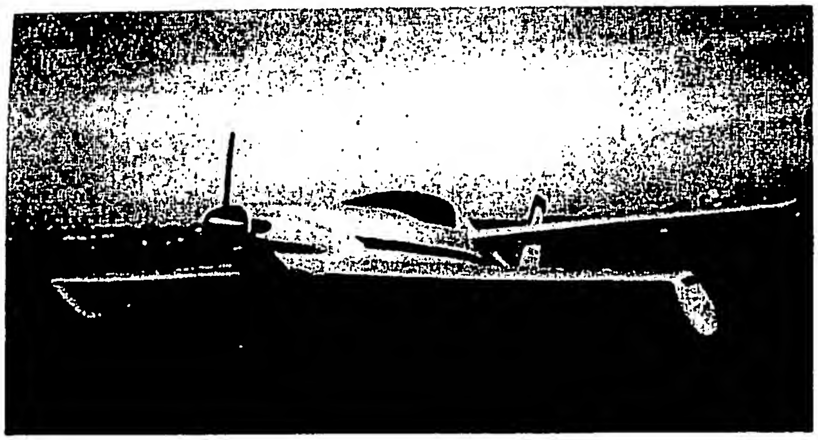
KC-X	Company				www
LDA-01, LDA-1000	Boxer				www
Long EZ	Rutan Aircraft Factory, Inc.	Burt Rutan, John Roncz	Experimental	Plans	www
MiG-35	MiG-MAPO		Military		www
Proteus	Scaled Composites, LLC	Burt Rutan			
Quickie	Quickie Aircraft Corporation	Burt Rutan, Tom Jewett, Gene Sheehan	Experimental	Plans	www
Quickie Q2	Quickie Aircraft Corporation	Burt Rutan, Tom Jewett, Gene Sheehan	Experimental	Kit	www
Quickie Q200	Quickie Aircraft Corporation	Burt Rutan, Tom Jewett, Gene Sheehan	Experimental	Kit	www
Rafale	Dassault		Military		
S-37 "Berkut"	Sukhoi		Military		www
Solitaire	Rutan Aircraft Factory, Inc.	Burt Rutan	Experimental		
Speed Canard	Gyroflug		GA		
SQ2000	KLS Composites, Inc.		Experimental	Kit	
Starship (Model 2000)	Raytheon Aircraft Company (Beech Aircraft Corporation)	Burt Rutan	GA	Complete	www
Stratos		Charles Ligeti	Experimental		www
Triumph	Scaled Composites, LLC	Burt Rutan			
Tu-144	PSC Tupolev				www
Typhoon	Eurofighter		Military		
VariEze	Rutan Aircraft Factory, Inc.	Burt Rutan	Experimental	Plans	
VariViggen	Rutan Aircraft Factory, Inc.	Burt Rutan	Experimental	Plans	
Velocity	Velocity Inc.	Dan Maher (based on Long EZ)	Experimental	Kit	www
Viggen 37	Saab		Military		www
Voyager		Burt Rutan			
X-29					www
X-31A	Rockwell International				www
X-50 Dragonfly UAV/VTOL	Boeing				www
XB-70A Valkyrie					www
XP-55 Ascender	Curtiss-Wright	Donovan Berlin	Military		www

Please submit any missing aircraft information and links to the site administrator.

Attachment 7

Dragonfly

C



The Dragonfly is a low cost, homebuilt sport plane with a canard planform. The canard design provides low wing loading to produce exciting performance with a VW based engine. This 2 place composite design can be built from plans or can be quick built using pre-fab parts. The Dragonfly was awarded "Best New Design" at the EAA's 1980 Oshkosh Convention.

DRAGONFLY SPECIFICATIONS	
Span	22'
Length	19'
Engine	2180 70HP VW
Empty Weight	600 LBS
Useful Load	545 LBS. MAX.
Wing Area	92.2 SQ. FT.
Seats	2 SIDE BY SIDE

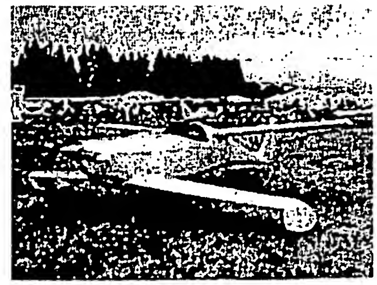
DRAGONFLY PERFORMANCE	
Take Off Distance	1200 FT
Stall	48 MPH
Landing Speed	N/A
Cruise	165 MPH
Rate Of Climb	850 FPM

Quickie Aircraft

C

From Wikipedia, the free encyclopedia
(Redirected from Quickie Aircraft Corporation)

The **Quickie Aircraft Corporation** was founded in Mojave, California, in 1978 to market the Quickie homebuilt aircraft (models **Quickie**, **Quickie Q2**, and **Quickie Q200** aircraft) which were designed by Burt Rutan and founders Gene Sheehan and Tom Jewett. Now defunct, the company sold over 2,000 kits in its lifetime.



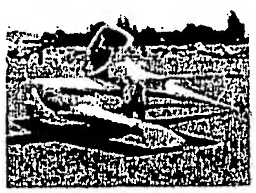
A Quickie Q2, with vortex generators on the canard.

External links

- Quickie Plans History Newsletters and Discussion Forum (http://www.quickheads.com/)
- Aerofiles.com data on QAC (http://www.aerofiles.com/_pl.html#_Q)
- Quickie Builders Files and Photos (http://imageevent.com/qdf_files)

Gallery

QAC Quickie Q2 in flight



QAC Quickie Q2, canopy up

QAC Quickie Q2, side view

Retrieved from "http://en.wikipedia.org/wiki/Quickie_Aircraft"

Categories: Aeronautical company stubs | Aircraft manufacturers of the United States